

BY WILLIAM BEEBE

**GALÁPAGOS: WORLD'S END
JUNGLE DAYS
THE *Archipelago* ADVENTURE**

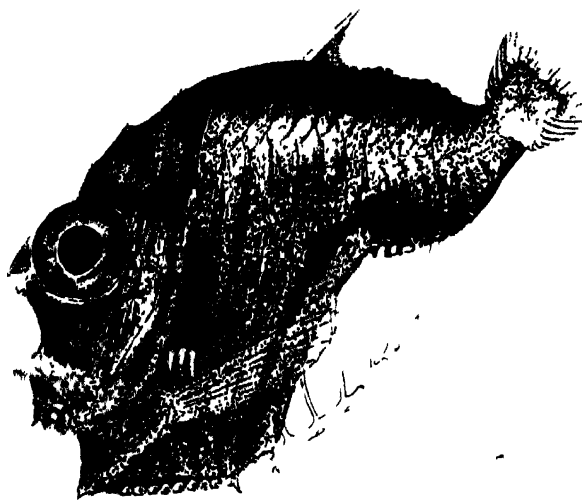
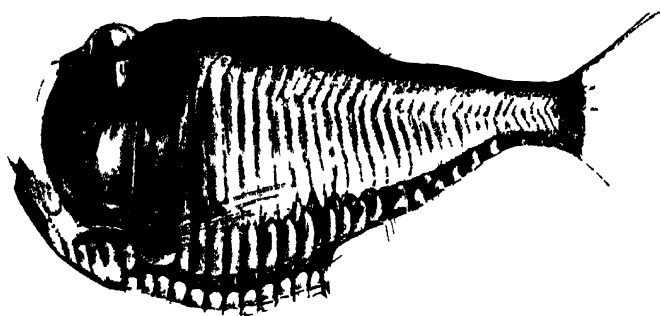


FIG. B

FIG. A. *Argyrolepecus*. A LUMINESCENT DEEP-SEA FISH WITH EYES DIRECTED UPWARD

(Twice natural size)

FIG. B. *Sternoptyx*. A COMMON DEEP-SEA FISH WITH PART OF THE INNER FIN SKELETON VISIBLE OUTSIDE OF THE BODY

(Twice natural size)

THE ARCTURUS ADVENTURE

*An Account of the New York Zoological Society's
First Oceanographic Expedition*

BY
WILLIAM BEEBE

Director of the Department of Tropical Research

WITH 77 ILLUSTRATIONS FROM COLORED PLATES,
PHOTOGRAPHS AND MAPS

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Go

ALL THE GALLANT NAVIGATORS

from

*Christopher Columbus to the Prince of Monaco
who have laid firm the foundations of oceanography*

and to

the generous patrons of this work

from

Queen Isabella to Henry Whiton and Harrison Williams

PREFACE -

THE origin and evolution of life, men and expeditions are interesting. On the very day of my return from the Galápagos in the *Noma*, I was introduced to a recently elected member of the Board of Managers of the New York Zoological Society, Henry D. Whiton. Mr. Whiton said to me, "You seem tremendously interested in the Galápagos; if you ever want to go back there I will furnish the steamer if you can get someone else to provide the coal." So from this generous, tentative beginning there crystallized the twenty-four hundred ton steam yacht *Arcturus*, the specified coal, a splendid oceanographic outfit, a captain and a crew, and an expedition of six months' duration, which steamed from New York to the Sargasso Sea, thence to Cocos and the Galápagos, and which secured a host of treasures, from the most microscopic beings which contribute to the surface luminescence of the sea, to a giant devilfish weighing more than a ton.

The two chief contributors to the expedition were Henry D. Whiton, who gave the *Arcturus*, and Harrison Williams who provided three-fourths of the entire cost. Other generous contributors were Marshall Field, Clarence Dillon,

Vincent Astor, the American Museum, George F. Baker, Jr., Arthur T. Newbold, Thomas S. Yates and Junius S. Morgan. Other gifts to be recorded are a sounding machine from William H. Trotter; sets of oceanographic books from Frederic C. Walcott; motion picture negatives from George Eastman; flashlights and batteries from the National Carbon Co.; a powerful radio set from the Stromberg-Carlson Mfg. Co. and the launch *Pawnee* from Harry Payne Bingham. To Ernest Lester Jones, Chief of the Coast and Geodetic Survey, I am obliged for a host of kindnesses and the loan of valuable instruments, and to the U. S. Fisheries Bureau for the *Albatross* launch and much valuable gear.

The entire responsibility for the sea-going condition of the *Arcturus*, her complete overhauling and the supervision of the building of laboratories, dark-rooms, refrigerators and oceanographic apparatus was assumed by Mr. J. R. Gordon and the naval architect, Edwin C. Bennett. Capt. Yates acted throughout for Mr. Williams, and it is to the whole-hearted enthusiasm and interest of these gentlemen that the smoothness of operation and general success of the mechanical basis of the expedition was due.

For Captain Howes and First Mate McLaughlin I have nothing but single-minded praise. No more willing, patient and capable seamen ever existed.

Several guests of honor joined the expedition for more or less brief stages, among them being

Prof. Henry Fairfield Osborn, Mr. Gregory Bateson, Mr. Herbert Satterlee and Miss Mabel Satterlee, Mrs. George Putnam and her son David, and Miss Margaret McElroy.

The scientific staff was of my own choosing, each of the seventeen members having a definite field of work, which they filled to the full extent of their ability. Without their loyalty, constant enthusiasm and coöperation, nothing of success could have been achieved.

The scientific working personnel was as follows: William Beebe, Director; W. K. Gregory, Associate in Vertebrates; L. Segal, Associate in Special Problems; C. J. Fish, Associate in Diatoms and Crustacea; John Tee-Van, General Assistant; William H. Merriam, Assistant in Field Work; Isabel Cooper and Helen Tee-Van, Scientific Artists; Ruth Rose, Historian and Technician; M. D. Fish, Assistant in Larval Fish; Elizabeth Trotter, Assistant in Fish Problems; Dwight Franklin, Assistant in Fish Preparation; Jay F. W. Pierson, Assistant in Macroplankton; Don Dickerman, Assistant artist; E. B. Schøedsack, Assistant in Photography; Serge Chetyrkin, Preparator; D. W. Cady, Surgeon.

The interest taken in the expedition was astonishingly deep and wide-spread, and the publicity was accurate and dignified. An unexpected result was the desire it aroused among several gentlemen to carry on oceanographic work in the same part of the world. Zane Grey visited the Galápagos in his three-masted schooner *Fisherman* after a con-

ference concerning the possibilities of big-game fishing, and since then Harry Payne Bingham in his yacht *Pawnee*, and William K. Vanderbilt in the *Ara* have done most excellent oceanographic work, the former in the Caribbean and the latter in Galápagos waters. As late as March, 1926, Mr. Vanderbilt reported the Albemarle volcano as still in eruption.

The *Arcturus* Oceanographic Expedition, the ninth expedition of the Zoological Society, sailed from Brooklyn on February 11th, 1925, and returned to New York on July 30th. In the interval we steamed a distance of over 13,600 miles, touching at Norfolk, Bermuda, Panama, Cocos Island and the Galápagos. We brought back 11,000 feet of splendid motion picture film taken by E. B. Schoedsack, besides hundreds of colored plates and photographs. We established one hundred and thirteen stations, made hundreds of hauls with nets and dredges, threw overboard two thousand drift bottles containing data as to our identification, the date, latitude and longitude.

My object in this volume differs in no respect from that of the account of my last expedition, *Galápagos: World's End*,—a scientifically accurate, popular presentation of the high lights and vivid experiences of the expedition. As yet there has been time and opportunity for the careful identification of only a few of the many thousands of specimens collected, so that in some instances technical names are lacking in this volume. Whenever identification has been possible I have included it

in the list of scientific names in Appendix B. Appendix A consists of a résumé of the bird life of Osborn Island. Beyond a final narrative chapter I have attempted no definite chronological journal.

All the details of operation, explanation of the apparatus, technical descriptions of specimens and of our individual problems, will be published in Volume VIII of *Zoologica*, the Zoological Society's scientific publication.

Chapters VI and X are wholly the work of Ruth Rose and in her rôle of Staff Historian she has collaborated with me in Chapters I, IX and XVI. Colored Plates IV and VI, and the book lining are the work of my Staff Artist, Isabel Cooper; Plate III is by Don Dickerman; Plate VIII by Dwight Franklin, while Plates I, II, V and VII are by Helen Tee-Van. In regard to the black and white illustrations, Figures 1, 4, 8, 49, 50, 59 and 60 are from drawings by Dwight Franklin; 31, 47 and 58 by Isabel Cooper; 36 by Don Dickerman; 12 and 18 by Charles Livingston Bull by permission of the Curtis Publishing Company; 2, 16, 56, 61 and 66 by John Tee-Van; 69 by Elwin R. Sanborn from the New York Aquarium, and 10 from the American Museum. All the remaining photographs are by Ernest Schoedsack.

OBJECTS AND ACCOMPLISHMENTS OF THE EXPEDITION

The avowed objects of the *Arcturus* Expedition were the investigation of the Sargasso Sea and the

Humboldt Current. Owing to continual storms the former was in such a disintegrated condition that I soon decided to postpone detailed study until a more favorable time. In the Pacific, to our surprise, we found that there was absolutely no trace of the Humboldt Current about the Galápagos. The inexplicable absence of this great, cold, Antarctic current was more than made up for by the presence of equally unexpected natural conditions.

Among the totally unexpected and inestimably valuable phenomena—the high lights of the expedition—were the great volcanic eruption on Albe-marle (Chapter V); the albatross rookery on Hood (Chapter IV); the remarkable results of hundreds of dives in a copper helmet and bathing suit (Chapters III, VII, IX, XI and XII); the discovery in New York of a dramatic personage who had sought pirate treasure on Cocos for two decades (Chapter X); the temporary current rip in mid-ocean (Chapter II); and the deep sea work in the submerged Hudson Gorge, only one hundred miles from New York City (Chapter XV).

Finally, the accomplishment which, scientifically, proved the most valuable of all, was the result of my decision to make a ten-day stay in one spot in mid-ocean, Station 74 (Chapters XIII and XIV), where continual dredging yielded very remarkable collections of fish and crustacea, equivalent to any two months of the less intensive work. In fact the crustacea taken at Station 74 equal 80% of all the rest which we took in the Pacific.

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Painted by Dwight Franklin. * *Frontispiece*

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THE *ARCTURUS* ADVENTURE

THE *ARCTURUS* ADVENTURE

CHAPTER I

SARGASSO WEEDS AND WAVES

BY WILLIAM BEEBE AND RUTH ROSE

MOST amazingly I am floating in midspace beneath a dense grape arbor with the sun shining through a mat of yellow-green leaves and the unripe fruit glowing like myriads of jade beads. Then the air becomes chokingly oppressive—I gasp—kick out violently with my feet and shoot up through the tangled mass of olive growth. Dripping like Neptune, wreathed like Bacchus, my head breaks water in mid-ocean in a mass of sargassum weed—a thousand miles from land. Nothing is in sight except the sliding hillside of an appallingly steep but smooth swell bearing down upon me, until I shake the water from my eyes, brush aside the dangling strands and, twisting about, behold the huge bulk of the *Arcturus* silently lifting and settling a few dozen yards away. This is my first fish-eye-view of the Sargasso Sea, on the only day for weeks which is calm enough for a swim.

The thought of a grape arbor as seen from below is more than a simile of these hanging gardens, and far from original, for about three centuries ago a Portuguese spoke of them as *salgazo* or “little grapes.”

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While the sargassum may be falsely reported to have been the weed that clogged a thousand ships, yet it undoubtedly played a most important part in the discovery of America. Mutiny among the crews of Columbus was too much of a menace for the comforting daily sight of drifting vegetation not to be a very real mental anodyne.

"They were astonished" writes an old translator of Columbus' journal, "when they saw the sea, in a manner, covered with green and yellow weeds, which seemd to have been lately washed away from some rock or island. This phenomenon gave them reason to conclude that they were near some land, especially as they perceived a live crab floating among the weeds." And a week later they saw "a tropicbird and such a quantity of weeds as alarmed the crew who began to fear that their course would be impeded."

When rumor and legend and travellers' tales need renewed basis of fact they always turn again to the Sargasso Sea. The supposed graveyard of ships has ever been the incubator of fancies. The great heart of the Atlantic has been credited with powers which make of it almost a sentient monster,—it can draw to it ships and men, can hold them indefinitely, spew them forth, or pull them down to black, soul-crushing depths. Its vegetation is as dense as baled hay and has the holding power of an octopus tentacle!

It is a terrible thing to me to destroy beliefs and legends. Knowing however, that there were no



FIG. 1.—THE LITTLE SEA DEVIL OF THE *Arcturus*
Diabolidium arcturi Beebe.
Three times natural size.

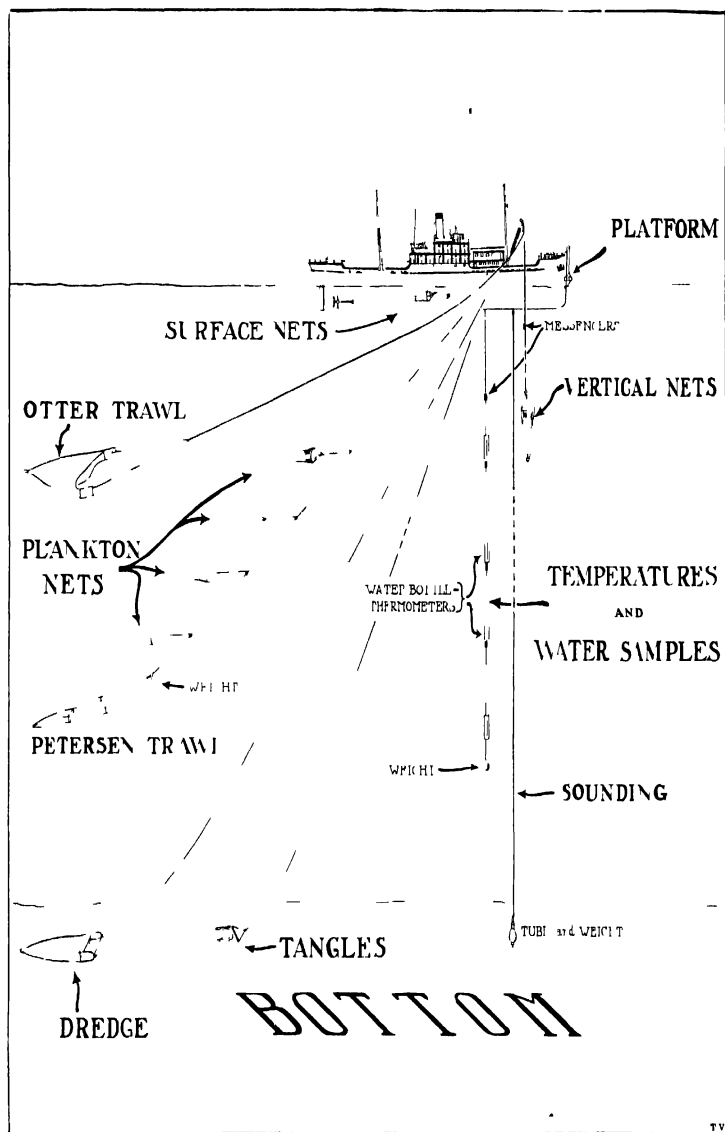


Fig. 2. DIAGRAMMATIC VIEW OF THE OCEANOGRAPHIC APPARATUS OF THE *Albatross*.

Nets, trawls, dredges, etc., used in studying the life of the sea.

fleets of vessels held captive by the sea of weed, I had nothing to abjure when I found that the only wrecks were dissolute Welsh colliers wallowing past on their unpainted way.

The mere mention of the Sargasso Sea in the list of my intended objectives was enough to inspire a whole crop of colored Sunday supplements of ancient weed-clogged vessels. As a matter of fact, realizing that scores of sailing vessels and steamers had traversed this sea again and again, and that the fauna of the weed itself was as limited as it was interesting, my object in this area was quite definite and unique. On my numerous trips from New York to British Guiana I had now and then seen, tantalizingly near, weed of considerable extent, sometimes one or two acres matted together—a golden-yellow undulating meadow. All that I asked of the Sargasso Sea was a duplication of such a meadow which I had seen more than once in areas well outside the conventionally mapped area of weeds. I hoped that the shallow and mid-sea life beneath, ranging from 100 to 500 fathoms deep, fed by the untold myriads of dead creatures falling slowly from the weed through the water, would yield hauls of unexcelled richness.

In February I took the *Arcturus* from Bermuda southeastward straight through the heart of this sea, then east, almost to its furthestmost limits. Months later on our return I again steamed through a great section, this time farther to the north. We saw numberless patches of weed, but seldom any which were larger than a man's head. For many

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days, in storm and calm, these averaged one to every square hundred yards. So my Sargasso Sea failed, in the aggregate, to materialize and I contented myself with the thousand and one other interests and problems which always rush in to fill such a vacuum.

When, in the very heart of the sea, I found only small heads or mats of weed I should have been truly desolate were it not that the explanation was of exceedingly great interest. It made the Sargasso Sea more familiar, less sinister; it showed that even in this shifting, plastic, nomadic, open-work island there were definite seasons. An eternal spring or autumn or winter is a frightful thing to contemplate, while a succession of seasons links the very antipodes with our home backyard. Dunsany well knew how to destroy an alien feeling—to connect the extremes of geologic ages—when he began a tale with the sentence, "It was a cold winter's evening late in the Stone Age."

And so this region lost much of its inimical character when I realized that I could say of my visit, "It was a late autumn day in the Sargasso Sea." My experience demonstrated an incisive difference between an undertaking dealing with business, religion or politics on one hand, and science on the other. We had set out to find vast fields of the weed teeming with living creatures, and we found only small mats and plaques almost destitute of life. A negative result such as this would be accounted a failure in business or hopeless in religion. To science it was of concrete value and added a

wholly new interest to the entire problem. Simultaneously with the disappointment at not seeing the fragments of weeds united into vast fields, came the certainty that following this autumn and winter, there must come spring and summer to these sunken meadows.

Although life was at lowest ebb yet the sargassum itself was in full growth. Day by day as we steamed eastward the weed became fresher and cleaner. The dark-colored, older portions disappeared in the heart of the new branches. Each bunch sent tiny sprigs up into the air, a valiant effort on the part of a poor, aquatic relation to share the thinner medium with the forests and flowers and fruits of the dry earth.

The origin and maintenance of the Sargasso Sea is still a moot question, whether the vast area is replenished annually by fragments storm-torn from the rocks of shallow coastal waters and poured forth by the Gulf Stream, or whether the weed perpetuates itself by continuous growth. Like the familiar banana, there are no seeds or spores formed in mid-ocean, but the growth of new, pale-yellow fronds and bladders is vigorous and constant. After my experience on this expedition I have no doubt whatever that the weed can propagate itself, vegetating, for a great many years if not perennially. When I kept masses of it in running water in aquariums, the older portions soon died from some excess or lack of light or heat. When I picked these pieces up by the newly sprouted fresh tips they would break off by their own weight,

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the old growth sinking to the bottom, while the newer sprigs and bladders rose and floated buoyantly at the surface. This would seem to account for the great abundance of wholly new heads which I observed in the heart of the area, quite devoid of any down-pulling old growths. I have no doubt that in a vast number of cases the sprouts are automatically detached at the point of juncture, either by the turbulence of the waves or after the whole has been pulled under water for some distance. That there is a certain amount of constant replenishment from coastal plants there is no doubt, but I think this is of minor importance in the maintenance of the Sargasso Sea as a whole.

The great age of the Sargasso Sea is attested by the specially adapted organisms,—fish, crustaceans, worms, anemones—which inhabit it, while the extreme reluctance of these to leave the shelter of even a tiny frond is a powerful argument against any wholesale, rapid, annual replacement of the oceanic weed-drift by fresh supplies from shore. Although we seemed to have arrived in the winter of the sargassum fauna, yet we collected 95 per cent of the known crustacea and other groups in proportion.

An unexpected coincidence is infinitely more exciting and interesting than the fulfillment of a preconceived plan: Hence my delight at discovering that my most interesting days in the Sargasso Sea occurred at the same spot in mid-ocean as the most dramatic points of Columbus' first voyage.

My mind went back to the details of that expedition and as the sublime may be compared with the ridiculous, so I compare the efforts of Columbus with my own. How absurd and petty became the few delays and disappointments of my preparations when I recalled the years and years during which he passed from country to country, trying to make his convictions real, his ideals practical to one sovereign after another. The entire cost of outfitting the three caravels of Columbus was \$7,203.73 but, while this seems like an astonishingly small sum, we must remember that the purchasing power of coin at the end of the fifteenth century, for ships, labor and food, was at least twelve times what it is today. Hence it is probable that seven thousand dollars in 1492 would equal eighty thousand today. However, we must agree with Thatcher that "Under any circumstances, whether we consider the maravedis expended or the results achieved, we may regard it as the most fortunate outlay of money since gold and silver and copper were minted into coin."

Here was I with my one vessel, on an expedition which was to cost more than twenty times Columbus' original outlay, with hope of results, which even at the maximum, could be considered only as a burlesque upon his achievement. And as a final commentary let us recall that, as a result of his being the first individual on his own expedition to detect the certainty of western land, he was rewarded by the munificent annual grant of ten thousand maravedis, or sixty-one dollars, a perquisite or

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tip derived from the profits of the slaughter houses of Seville!

Perhaps the best way of visualizing our life and adventures in the Sargasso Sea will be to compare them with the notes of Columbus made upon geographically identical days of his memorable voyage.

SEPTEMBER 23RD, 1492, CHRISTOPHER COLUMBUS WROTE IN HIS JOURNAL, "WE SAW A TROPICBIRD."

On the 28th of February, 1925, on the *Arcturus*, so exactly at Columbus' location, that four hundred and thirty-three years before we would probably have been within sight of the *Santa Maria*, the dismal bleat of a tin fish-horn woke me. I slid out of my berth on the next roll of the ship and groped sleepily for dressing-gown and slippers that were arranged in fireman fashion ready to be donned. The captain and officers of the *Arcturus* had been instructed to blow the horn whenever they sighted any living thing, and their eyes were uncommonly sharp.

Like figures in a demented Swiss weather indicator, the port cabins simultaneously decanted a row of bathrobed observers, who peered earnestly at heaving grey sea and lowering grey sky. It was that dreary hour of dawn when the whole world is grey, without a hint of the color-bringing sun. Shivering, we lined up at the rail in time to see a snow-white tropicbird skim past the wireless structure, his two elongated tail-feathers trailing like a foamy wake.

There was a notable lack of enthusiasm at this sight. It was the fifth morning that we had leapt out at dawn to see the same bird, who appeared to take delight in coming only at this hour. The spectacle had somewhat lost its charm, not to speak of its novelty, but the officer on duty, like one of the immortal Six Hundred, refused to reason why. I also suspect that he enjoyed making us get up.

As we turned back to our cabins, one morose scientist was heard to mutter, "It may be bad luck to shoot an albatross, but I'd like to take a chance on that tropicbird."

Life is strenuous on an oceanic expedition, and on the previous evening our nets had brought in a rich haul of fishes from the depths, and my late session in the laboratory had lasted until three. So now I lazily determined on another half-hour in bed. Just as I was comfortably dozing off, there was a scrambling at the open porthole, and with a thud Chiriqui dropped on my chest.

Chiriqui is the small Panamanian monkey who has been the indispensable mascot of three expeditions of the New York Zoological Society. He is a much travelled and thoroughly spoiled person, and in his more destructive moments is known as Rasputin, the Demon Monk. His uncanny ability to escape from confinement causes him to be referred to also as Houdini, and the exercise of this talent accounted for his presence now. Having apparently toiled all night, he had at length succeeded in breaking out of jail, as represented by his enormous cage on the forward deck, and grinning with fiendish de-

light he turned three somersaults on my prostrate form, concluding the performance by scaling the life-preserver rack and from that eminence hurling himself at my head.

Feeling gloomily Shakespearean, I informed him that he had murdered sleep, and hurriedly dressed, with a wary eye on him and the more perishable articles in the cabin. He is living proof of the prestidigitator's boast that the hand is quicker than the eye, and with three snatches he can irremediably wreck as many objects. To the accompaniment of his protesting shrieks, I returned him to his prison, repaired the hole through which he had escaped, and descended to the main deck for a half-hour of work in the laboratory before breakfast.

On this, as on previous days, early morning found the ship wallowing through the endless procession of great surges which rolled tirelessly up from the south. Only thin streamers of weed, sometimes extending for a mile or two, undulated over the leaden sea. The use of the intricate deck machinery which operates our diversified gear was complicated still further by the incessant and violent motion of the vessel. We had become experts in balancing and, at a preliminary cost of a good deal of breakage, in knowing just how far we could roll before laboratory equipment suffered a sea-change into something new and strange in the way of wreckage.

Some of the scenes in the laboratory during those first stormy days defy description. An agonized scientist, caught unawares by a particularly vicious



FIG. 3.—THE BOOM WALK OVER THE SIDE OF THE *Arcturion*.
This permitted access to the untroubled water thirty feet away from the vessel.

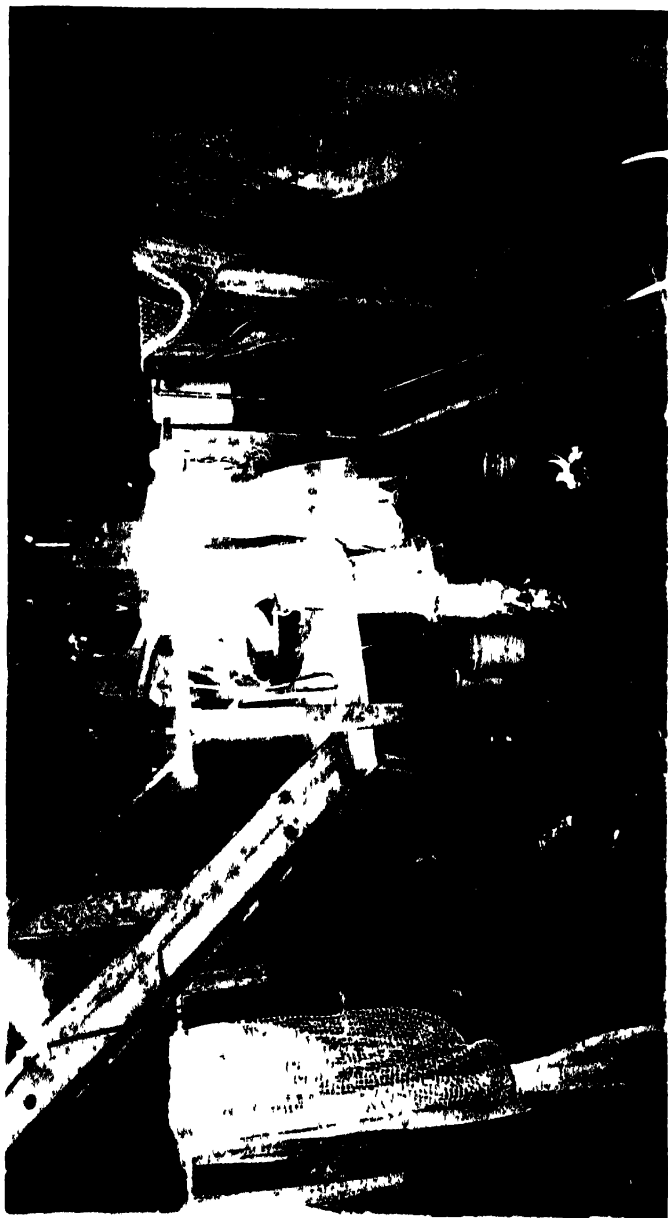


FIG 4 — FORWARD HOLD OF THE *IRCHUKUS* WHERE ALL THE APPARATUS FOR THE VOYAGE WAS STOWED

lurch, would find himself far from refuge, in the midst of a steep deck made glassy by water, alcohol, formalin and other liquids that spilled from various directions. With hands too full of precious and breakable objects to grasp at a straw, he would skate helplessly down the incline, seeming bent on dashing his head against the wall, while the rest of us, bent over desks and clinging to sliding microscopes and specimens, could throw him nothing more helpful than anxious looks and cries of encouragement.

COLUMBUS, FROM HIS POINT OF OBSERVATION ON THE HIGH POOP OF HIS CARAVEL, LOOKED OUT OVER THE SAME EXTENT OF OCEAN AS I WAS NOW WATCHING. HIS HISTORIAN TELLS US: "THE AIR WAS SOFT AND REFRESHING, AND THE ADMIRAL SAYS NOTHING WAS WANTING BUT THE SINGING OF THE NIGHTINGALE; THE SEA SMOOTH AS A RIVER. MANY WEEDS APPEARED."

This fifth morning of the tropicbird's alarm-clock appearance held the promise of being fair. Soon after sunrise the terrific swell went down and before noon the sea was the smoothest we had so far encountered. I spent an hour in the pulpit and lest any Fundamentalist be startled by the connection of pulpit and science, I hasten to explain that it is one of the several queer contraptions that make the *Arcturus* a mystery ship to passing vessels. On every sea trip I have ever taken, my favorite position is as far out on the bow as possible,

looking enviously down at the floating creatures which are constantly passing. And now I had devised this pulpit which answered every requirement. It is a bit of iron grating, surrounded by a waist-high iron rail and fastened astride the bow of the *Arcturus*. It can be raised or lowered to any desired position, and this morning the weather was so promising that the supporting cables were let out to their fullest extent, so that the grating was now and then hidden by a rush of water as the ship dipped forward into a smooth billow.

The first descent of the swaying pilot-ladder was an uneasy experience, but one was not at all likely to fall when the possibility of falling was so evident,—provided, of course, that one had a “head for height.” For a while I think that the captain suffered more anxiety than anyone, as from his vantage point on the bridge he witnessed the disappearance of land-lubbers over the very point of the bow. Once in the pulpit, the sensation was rather like being in Mahomet’s coffin, suspended between sky and sea, with nothing under foot but a few strips of widely-spaced metal, hanging under the cliff-like bow of the forging vessel that slid down the watery slopes in a ceaseless attempt to overtake and crush me and my scant support. There was no sound but that of the rushing water cleaved and flung aside by the sharp prow. The sun’s rays tapered into a luminous cone that plumbed infinite blue depths just ahead, a hypnotizing focal point for dazzled eyes. From undulating blue meadows a school of flyingfish skittered like grass-

hoppers from a hay-field, and two or three of them skimmed knee-high across my little platform.

“THEY SAW” WE READ IN THE RECORD OF COLUMBUS’ VOYAGE, “VAST SCHOOLS OF TUNNY-FISH, AND THE PEOPLE ON THE *Nina* KILLED ONE. THE ADMIRAL SAYS THAT THOSE INDICATIONS CAME FROM THE WEST, ‘WHERE, I HOPE IN THE EXALTED GOD IN WHOSE HANDS ARE ALL VICTORIES, THAT LAND WILL VERY SOON APPEAR.’ ”

Standing in my pulpit, as I have said, I turned to watch the flyingfish plump back into their briefly deserted element, when a dark shadow shot through the water toward me,—the tunnies had come,—and after this hardly a day passed when from four to forty could not be seen, swift, violet torpedoes keeping as steadily in our path as if fastened in some inexplicable outboard manner to our keel. But today they did not remain long. I happened to be looking when the whole school turned, as one fish, and with lightning speed darted out of sight. The reason became apparent when seven advance scouts of a gang of dolphins rushed up and wheeled into line, attracted by the throb of our engines from heaven knows what distance, to that game of which dolphins never seem to tire.

I don’t suppose there is any more inspiring sight than a school of dolphins leaping round a ship. They are so unmistakably and thoroughly enjoying themselves, in their effortless rush and curving, easy leaps, that no one could help feeling that al-

most affectionate sympathy which is inspired by watching anything done superlatively well by someone who has tremendous fun in doing it. Right under my feet these friendly creatures now frolicked, so close that the lift and fall of the ship, sometimes synchronizing with their motion, made me feel that I was riding one of the powerful curved backs that slid from water to air and back again so smoothly as to throw scarcely a drop of spray. The torpedo bodies, perfectly fashioned for just this, accurately held the appointed distance from the ship and seemed not to move a muscle. Only close scrutiny revealed the terrific power of almost imperceptible strokes of the broad tail flanges.

My instant reaction to a school of dolphins is an irresistible desire to shout, and this, being the first combination of pulpit and dolphins, made me excitedly wishful for the laboratory toilers. I was too selfish to leave this delightful post in search of the rest, so I lifted up my voice in what seemed fruitless shrieks against the towering ship's side.

Presently a head peered anxiously over the rail far above me, and seeing that my cries were not for help but for appreciation, vanished for a moment and reappeared with an augmented audience. This was still in such an early stage of the cruise that the Captain suffered almost hourly pangs of apprehension by mistaking screams of enthusiasm for calls for succor. Long before the end of the six months' voyage nothing less than the wail of a banshee would have attracted his attention.

The capacity of the pulpit being three, two of

the audience joined me and for awhile we amused ourselves by trying to touch the gambolling dolphins as they shot up from the water. For half an hour or more we timed individual dolphins with a stop watch, and found that they came up for breath on an average of once every three minutes, the inhalation through the open blow-hole lasting from three-fifths to an entire second. Once we were thoroughly soaked by the plunge of the bow into a deep trough,—a breathless moment when the actual security of our position was forgotten and the whole ocean seemed to overwhelm us. When the dolphins tired of us and rushed away on some suddenly remembered errand, I mounted to the deck and lowered to the two who remained below the long-handled net with which specimens were scooped from the waves.

Pieces of weed were constantly passing, each one with its assortment of little beings who depended upon it for protection and whose lives were bounded by its fragile shelter. Sitting astride the bulwark, I hauled up a bucket full of weed, lowered an empty one into its place, and carried the catch down to the main deck, where it was put in a tub and carefully examined for its inhabitants. I remembered that I was not the first collector in this identical spot, since four centuries earlier a famous explorer had proved himself a worthy carcinologist;

“AT DAWN THEY SAW MANY MORE WEEDS,
APPARENTLY RIVER WEEDS, AND AMONG THEM
A LIVE CRAB, WHICH THE ADMIRAL KEPT”
(COLUMBUS’ DIARY).

18 THE *ARCTURUS* ADVENTURE

From my own modern bucket quaint things came forth,—innumerable tiny crabs and shrimps, perfectly disguised in the yellow-brown colors of the weed and even reproducing on their carapaces the shapes and tinges of the blemishes and parasites on their vegetable home; absurdly attenuated pipefish, hardly to be detected when in motion, so exactly could they imitate the undulation of a waving frond; naked mollusks, or Nudibranchs, incredible creatures that must be seen to be believed and cannot be described; infinitesimal worms and snails, furnishing food for larger forms and themselves finding some microscopic fodder in their watery jungle; and each species wrapping itself in a cloak of invisibility and melting into its background with magical completeness. The commonest crab was undoubtedly that which Columbus collected, and which bears the name of *Planes minutus*.

On the scattered bits of sargassum which we salvaged, I found many hints of the spring which was to come to this strange land of sea tares. Masses of snail eggs,—some in many-celled stages, like diminutive parodies of golf-balls, others with active embryos pushing and straining to break through the membranes and begin that series of hopes and fears which both snails and we call life. Now and then were skeins of fish eggs tangled inextricably among the fronds,—linear nurseries of thousands of brothers and sisters.

I took a little three-inch frond of weed into the laboratory and watched it under my binocular microscope. I pretended the common little inhabi-

tants were rare and began to observe instead of merely to see them. There were three kinds of hydroids,—the palms, the trees and the spiked clubs, all superlatively dainty and elegant, foresting these diminutive roof gardens of the sea. Here and there were more formal plantings, row upon row of beautiful ivory or alabaster chalices, from which sprang severe fountains of tentacles,—minute bryozoans or moss animals,—all arranged just so, like the alabaster vases of Italian gardens. The bryozoan beds were still exquisite when their occupants were dead and gone. The sere and autumn of the moss animals' year left a mosaic of thousands of flattened hexagons as perfect as honeycombs, as translucent as age-old moonstone.

These serried ranks of the bryozoan folk are all flattened against their world of weed, but the wavering groves of slender hydroids are connected at their base by rootlets or stolons which wander and weave about the fronds and the bladders. It is hard to say what are the relationships of a group of these little hydroid palms. Is the tall animal flower at the summit of the berry-like float the child or parent of the one behind, and these three which stand up tall in a row like the masts of a Lilliputian wireless station,—are they cousins or brothers? If however, we are confused at this relationship, what can we say of the actual transition from one generation to another,—as astounding as it would be for a cat to have geraniums instead of kittens, and the plant offspring to scatter puppies in place of seeds!

The discovery of our first specimen of *Pterophryne* drew everyone's attention; the youngest member of the staff took one look at the little creature and cried in honest ecstasy, "My Word!" and so it was christened on the spot, and so, during its brief span in our midst, it was affectionately called. I do not blame anyone for objecting to the adjective "fascinating" as applied to a fish, but I ask such a sceptic to wait until he has seen *Pterophryne*, the Sargasso Fish *par excellence*. From snout to tail-fin it was the piscine essence of the fronds, its fin rays produced into finger-like appendages, with which it crept about in the weed, swinging from frond to frond, dangling upside-down, and assuming postures that were irresistibly comic. Its foolish face was fixed in an expression of intense earnestness, and the stout little body performed amazing antics with the agility of a monkey. I hold no brief for fish as pets, but *Pterophryne* is the exception. Everyone who could draw clamored to paint this specimen, others inspected it with a view to determining the species, and some of us wished merely to watch it and chuckle. Soon the ghastly blue of Cooper-Hewitt lights issuing from the bridge-casing told that moving picture and still cameras were busily recording its appearance and activity. In my journal I find a sad note for the evening of that date; "'My Word' died of publicity." He had his crowded hour.

Elsewhere I shall describe more in detail the various forms of apparatus used on the *Arcturus*,

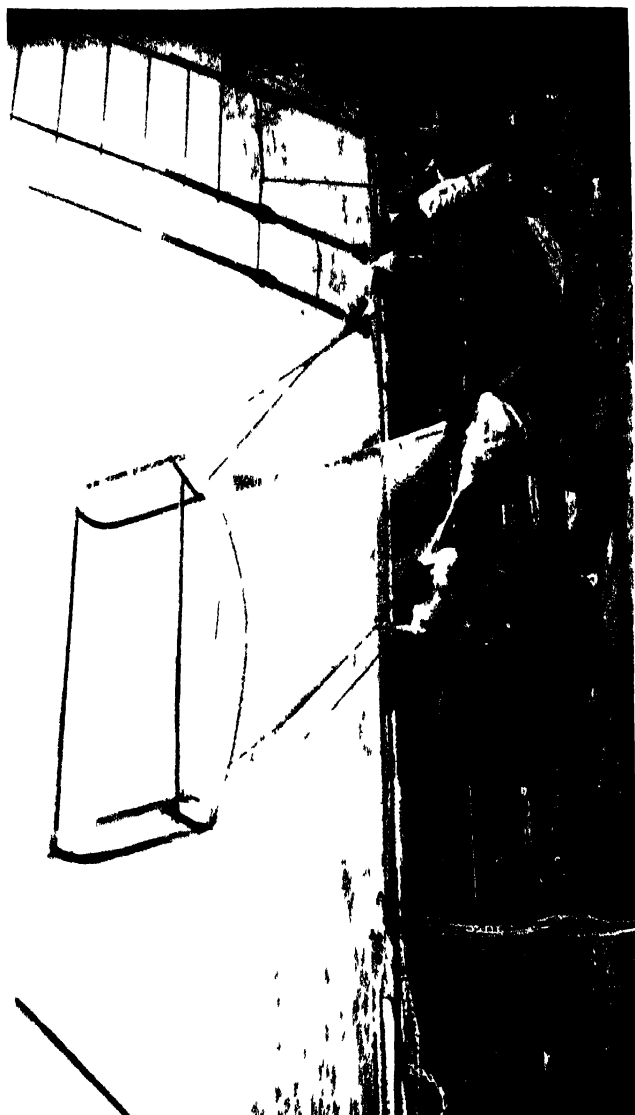


FIG 5.—THE LARGE DREDGE BEING HAULED IN AFTER DRAGGING ALONG THE BOTTOM FOR TWO HOURS AT A DEPTH OF ONE MILE.

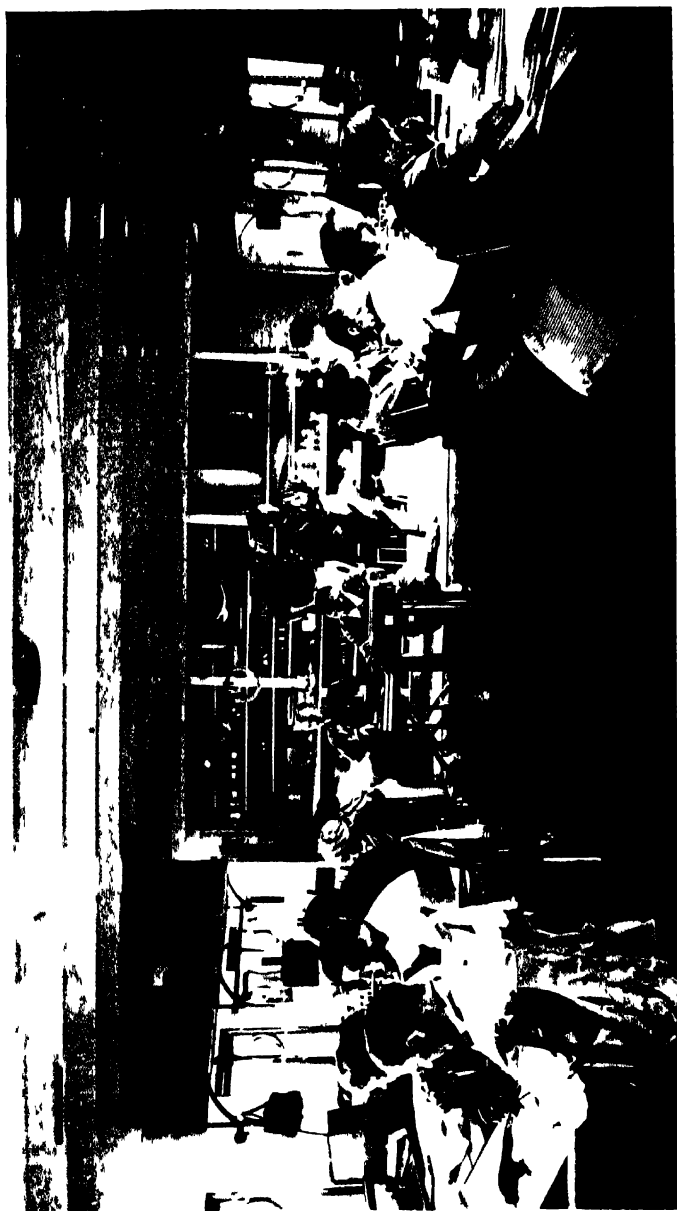


FIG. 6. SCIENTIFIC STAFF OF THE *Chubu* AT WORK IN THE LABORATORY

but I must mention the boom-walk before going on to the deep-sea part of our typical Sargasso day. When I saw the *Arcturus* in dry-dock the thought came to me how much of a vessel is outside and how little anyone has ever made use of it. I remembered Howard Pyle's drawing of a pirate's captive walking the plank and I made up my mind to adapt this to the uses of an oceanographic expedition. I fashioned two thirty-foot booms rigged outboard on the port side, one slightly above the other and about three feet apart. To these, by a many-looped rope I laced a duckboard walk. When swung at right angles to the vessel's side and firmly guyed, I had a perfectly safe runway extending far out from the ship and over quiet water, beyond the foaming wave thrown up by the passage of the *Arcturus* on her course. I could walk out in calm or in storm and, from a curious, semi-detached view-point, contemplate the ship plunging through the water. One was of the vessel, and yet not exactly in it nor on it, a state of mind which may resemble that of a soul in its astral body looking back upon its corporeal one. Searching for a name that should express the feeling of this position, we hit upon the Fourth Dimension as most appropriate.

In the trough of a swell which looked considerable but felt mighty, the tip of the boom described a great arc, swinging far up into the air until one looked down from an appalling height on the main deck, then swooping waveward with such velocity that a salt bath seemed inevitable. It

was a glorious experience if one was a good sailor.

The uses of the boom-walk proved to be manifold, so much so, indeed, that the Captain came to me one day to apologize for the scepticism which he had shared with marine engineers and others in the ship-yard where the weird contraption had been made and attached. Trailing silk surface nets from the extreme end of the boom-walk proved infinitely more effective than the conventional method of trailing them over the stern in the roiled and disturbed wake. When we were anchored I was able to use the outboard walk as an auxiliary boat boom, or a place from which I could make a descent in my diving helmet even at night. The sounding davit was fixed half way out and we trolled for and harpooned dolphin fish and sharks, besides using it for photography, and catching up weed, fish and organisms of all kind. In fact this, together with the pulpit, increased our totality of effectiveness to an astonishing degree.

Among the host of creatures which we took in quarts of plankton in our surface nets by day and by night in the Sargasso Sea, one is especially worthy of mention in this place.

Leptocephalus is a general, ignorance-confessing name given to the larval form of eels (Fig. 10). My first introduction was when I looked at a small aquarium of plankton and saw a half dozen mother-of-pearl eyes swimming around quite by themselves. This was after I had been studying plankton for a few dozen hauls, and had passed the stage of wondering whether excess of microscopic work was

working injury to my eyesight. Yet even now I did not quite believe what I saw, until I dipped in my hand and lifted out a twelve-inch piece of flexible water. There was absolutely no structure to be seen except the gleaming eyes, and yet here was a living fish. When dead and preserved, the body, shaped like a long thin willow leaf, became translucent and then it was possible to make out the hundred-odd delicate segments and the all but invisible gills and stomach. When the head was placed under the microscope there leaped into view a regular old-fashioned dragon, with enormously long, sabre teeth, which, were the animal twelve feet instead of twelve inches in length, would make it infinitely more dangerous than the largest anaconda. In the Sargasso Sea we took hundreds of specimens of many species, only a very few of which can be accurately identified, for the reason that we lack the connecting stages between these indefinite water wafers of organisms, and the more palpable adult fish.

The history of two forms of *Leptocephalus* has only very recently been worked out, and is another of the inexplicable complexities of nature, which to our practical, human minds seems an absolute waste of energy. To Dr. Johs. Schmidt belongs much of the credit for the patient unravelling of this astounding problem. As *Leptocephalus* is strange as any dragon in a fairy tale, so its life history equals the unreality of any fairy tale itself.

Briefly, these watery beings which, at night, we captured in dozens in our surface nets, are hatched

from eggs which are deposited not far south of my first Sargasso objective, 30° North and 60° West. At least two species of these tiny, new-born *Leptocephali* soon begin to swim slowly northward, reaching the latitude of Bermuda within the first year. They then separate into two mighty streams. The one which swings westward develops rather rapidly and soon after the first year has changed into young eels or elvers, and, guided by some instinct to which we have not the slightest clue, seeks the various fresh-water streams and rivers from Florida to Canada from which a year or more before, their parent eels emerged.

The offspring of European eels, on the contrary, turn to the east and take three years to reach the mouths of their ancestral rivers—be they British, Spanish, French or Norwegian. Here they wriggle slowly up the saltless currents, and after a dozen years or so, play their part in this marvelously intricate round of life. In a single haul of a metre net at 30° North and 60° West it is possible that we captured two *Leptocephali*,—one of which would have completed its growth in the farthest tributary of Lake Ontario, and the other in some little stream of the headwaters of the Rhine.

Why should such sedentary creatures, spending almost all their lives in a single reach of brook or stream, suddenly be moved to traverse thousands of miles of open ocean, braving voracious fish and cetaceans to lay their eggs in the Sargasso Sea close to an alien continent, when others of their class successfully spawn under the nearest pebble?

Is there a more dramatic phenomenon in the world than a whole generation of adult eels of two continents moving majestically in their millions,—setting out upon a voyage at the end of which each female will scatter her ten or more million eggs, and from which no eel will ever return! When, within a space of several years, learned ichthyologists wrote confidently of eels descending to salt water and, inside of a month, depositing their eggs close to shore, we can hardly afford to laugh at Aristotle who, two score centuries ago, stated that eels have no sexes, nor eggs, nor semen, and that they rise from the entrails of the sea.

So far on this day we had concerned ourselves only with the surface life of the ocean, but now we prepared for some deep sea work. The preliminary was to take soundings to determine how far down the large trawl could be lowered without scraping bottom. The warning word ran round the ship, "Watch your desks, she's going to roll." Of course we had to stop in order to sound, and everyone dreaded it, for it meant that the *Arcturus* would soon swing into the trough of the sea, and that everything not bolted, wedged, reinforced and clamped would take unto itself roller-skates or wings, or achieve the same effect. Talk about the origin of life upon the earth! no day passed without a score of examples, in full speed mutation time, of spontaneous generation, of metamorphoses of ink bottles, jars and filing boxes, into sepia lakes in which swam long preserved fish and over which fluttered innumerable snowflakes of catalogue

cards. In those days in the Sargasso Sea, that tried men's souls, as well as more material portions of their anatomy, we endeavored to accommodate ourselves to the whims of the ocean by voyaging as much as possible into a head-sea. Thus we only pitched, not nearly so distressing and violent a motion as rolling. If the ship fell off a bit, or it was necessary to change the course and an unexpected roll disturbed the laboratory toilers, there was never lacking some one to dart out and cast a black look toward the bridge, as one who would say "How dare you let this ship roll!" I suppose that this assumption of perfect control on the part of the Captain was really very flattering, if we could have made him see it in that way.

The engine room telegraph clanged around to "Stop!", the bulky iron weight and hollow sounding tube were fixed on the slender piano-wire and the humming descent to the depths commenced. So did the rolling. The boom-walk was already occupied by one man watching to see that the wire did not kink and another carefully taking the angle at which the wire entered the water.

The indicator-arm of the sounding machine at last jerked sharply downward as a signal that the weight had touched bottom and detached itself; a brief pause and the little motor began to whirr again, reeling in a mile and a half of wire, which, as it came, was wiped and greased before it reached the drum on which it was recoiled. Every time a sounding was taken a weight was abandoned on the bottom, and considering the number of sound-

ings that have been taken in years past, one's imagination pictures the ocean floor as thickly and bumpily carpeted with seventy-five-pound pear-shaped balls of iron. The cold light of statistics, however, reveals the fact that so little is actually known of the depths of the ocean that, outside the thousand-fathom line, there is in the Atlantic an average of only a single sounding record for each twelve thousand square miles. So, after all, the ocean bottom is far from being cobbled with iron.

When the sounding tube broke the surface on its return journey, and was emptied of the sample of the bottom which it had sucked up, any absurd fancy about man's puny efforts was banished. The dishful of *Globigerina* ooze was a pinch of the stuff with which millions of square miles of the submarine world are covered. Under the microscope the greyish white gravel resolved into the fragile shells of infinitesimal creatures, which in unthinkable quadrillions spend their lives floating near the surface and, dying, sink slowly through the black depths to add their tiny homes to the vast piles of their fellows'. In a world without color, because it is without light, totally lacking in vegetable life, where an unchanging iciness of temperature prevails, and where the pressure to the square inch amounts to an added ton for every added mile of depth, there are huge areas where the bottom is deeply covered over by the bleached remnants of these single-celled little beings, each smaller than a grain of sand. And over them swim and crawl

and grope forms of life that are too strange to be credited.

With the hope of getting some of these grotesque creatures of the deep, the big trawl was let over the side, and the cable began to run off the huge drum, passing through a succession of blocks that made it look as though a gigantic game of cat's-cradle was in progress on the forward deck, before it ran over the tip of the outswung boom and down into the water. At intervals of a hundred fathoms the unwinding process was checked long enough to attach a fine silk net to the cable, so that the various levels of the sea would be combed. We were once more under way, going at slowest speed—about two knots—so that too great a strain might not be put on nets and machinery, and though the ship rolled a bit now and then, it was no longer the catastrophic wallowing that made us long to be limpets. It was necessary to let out the cable slowly, as we had learned by experience. On one occasion when impatience overcame discretion, yells of horror greeted the sudden rising from the waves of a Gargantuan tangle, the result of too swift a descent that had allowed the cable to overtake itself in loops and coils and ingenious Gordian knots. The steam winch was checked only just in time to prevent the whole mass from striking the first block and working tremendous damage.

With the trawl at a depth of a mile, and five silk nets trailing at hundred-fathom intervals, we steamed slowly along for two hours. Deep-sea



FIG. 7. Harpoon line.



FIG. 8. Catching seal specimens.



FIG. 9. Forward view of the pulpit.
THREE VIEWS OF THE BOW PULPIT.

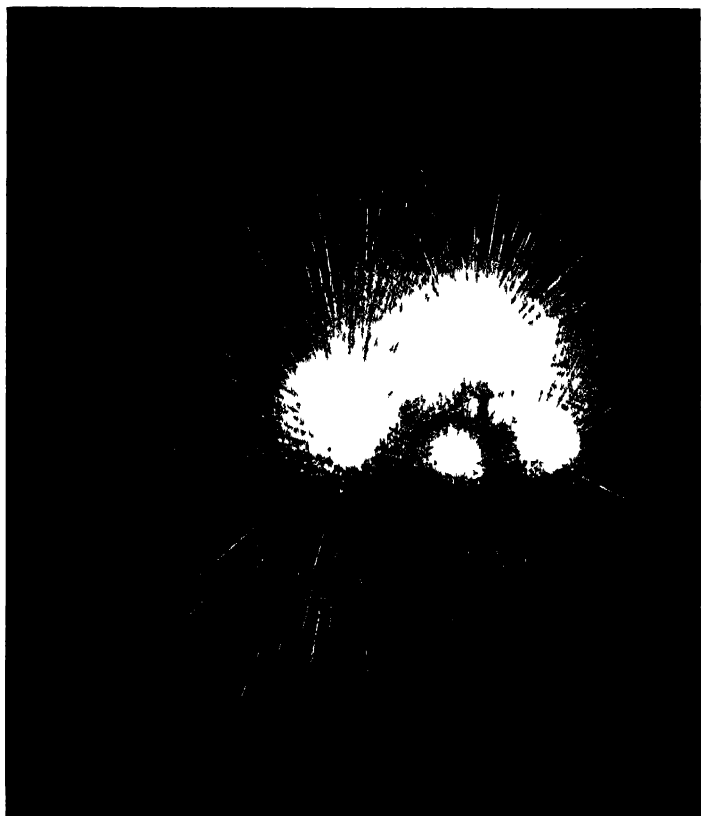


FIG. 10 THE BUBBLE GLOBIGERINA

One-celled animals living near the surface whose shells go to form the Globigerina ooze which covers thousands of miles of sea bottom



FIG. 11 FLATWORM LARVA

The flat translucent larval stage through which the young of flatworms pass

trawling is like an enormous—and expensive—grab-bag; after all the time and labor involved in putting over and bringing in the apparatus, the sum total of the effort may be nothing at all, or it may be a host of beings strange and rare, or absolutely new. The oceanographer can trust only to luck—aided somewhat, of course, by a knowledge of the sort of ocean bottom over which life is most likely to be abundant, and in some localities, by the experience of his predecessors in the work.

Finally the shout was heard, "Beaters wanted!" This sounded like an advertisement by the owner of a pheasant preserve, but was really the result of finding that the best way to dry the incoming cable was to knock off the water with heavy sticks. Two at a time, we took fifteen-minute turns in earnestly belaboring the big steel rope before it reached the drum on its return journey. At this moment listen, if you please, to the sounds on the deck of the *Arcturus*: The staccato whacks of the beaters, pounding in rhythm to the chanty of some ballad of old England, learned from our negro paddlers in Guiana jungles; this mingled with the rumble and clank of the winch; in the laboratory typewriters clattered, the Van Slyke machine operated by the chemist thudded swiftly; photographic lights fizzed and spluttered in the bridge-casing; the second mate, sacrificing his watch below, mended nets on the whirring electric sewing-machine; while over the mechanical uproar of the *Arcturus* sounded the shrill chatters and yelps that told of an argument between Chiriqui and the ship's

puppy—a canine of mysterious pedigree and unknown breed.

Descending into the forward hold for a fresh supply of vials, I delved among cases in the swaying shadows; here in the lowest depths of this wooden ship new noises drowned out everything that was happening above. The huge curving timbers of the framework might have been those of an old galleon, and the gobbets of red paint that showed where the bolts were placed were shudderingly reminiscent of those dreadful significant splashes with which, in fiction at least, all pirate ships are plentifully besprinkled. From the sounds it was easy to imagine that the vessel was on the point of disintegration; such creaks and groans must herald disaster, and when a large swell came, the grind of straining planks, and the volley of crackling, which might have come from a machine-gun nest, were deafening.

The first net was in; the winch stopped while it was detached and brought over the side and its contents gingerly emptied into glass dishes and bowls; four such nets were safely recovered, but something had gone wrong with the fifth, that which had been down to five hundred fathoms; the light ropes at its mouth had twisted, evidently on the way down, for it was wound up in such a way that nothing had been able to enter it. A certain percentage of such accidents is to be expected, but as the voyage went on, mishaps of this kind were rare.

The arrival of the big trawl was the signal for

a rush hour on the forward deck; everyone, except possibly the stokers and the officer on watch, crowded around to see the catch. After the first week the crew was convinced of our insanity. Their standard of excitement was governed entirely by size, and to see fourteen grown-up people go into ecstasies over such tiny specimens was to them one of the funniest and most inexplicable sights in the world. What if we did catch a fish whose eyes stood out on stalks almost half as long as its entire body, and through whose transparent skin a minute heart and nervous system were plainly visible? If the whole creature was less than three inches long, the crew derived nothing from it but a hearty laugh. As the majority of deep-sea animals are small, the sailors seldom lacked comedy. On one occasion, when there was a shout of "Whales astern!" and every door erupted flying figures that raced aft, the oldest able seaman, a big, bored Scandinavian, was heard to mutter, "I seen plenty whales. I never seen such funny folks."

There were hundreds of specimens that must be sorted out as fast as possible, and soon every desk in the laboratory had an absorbed worker, armed with forceps, spoons and pipettes, disentangling fish from sagittæ, crustaceans from jellyfish, squids from siphonophores. If it were only feasible to label the nets "For fish only," or "Jellyfish enter here"; the oceanographer's life would be much simplified. The heterogeneous mass that is scrambled together by a trailing net is mostly of such fragile structure that it seems a miracle to float out a

double handful in a dish of water and find that most of the animals are not damaged. It appears incredible that the contact with the net and the impact of the water on the upward journey should not crush all but the largest and toughest.

There was an excited shout from the dark-room that caused a stampede in that direction. In the nearly total blackness of that very inaccessible compartment, streaks and gleams and sparks of glowing light moved slowly and erratically about. In the babble of questions from a dozen people who were tripping over each other in the dark, I shouted out,

"Astronesthes and Oncirodes!"

This was not an ancient Grecian oath, but the names of two luminous deep-sea fishes that were nobly gratifying the hope with which they had been hurried into the dark-room. Brought up from a region where the pressure on their small bodies was hundreds of pounds to the square inch, into an unfamiliar zone where it amounted to only fifteen pounds, it was marvellous that they lived to reach the surface, to say nothing of continuing to exist long enough to show those little lights which up to this moment had been gliding about the cold blackness of the great depths.

Both of these particular ones were velvety black of skin. *Astronesthes* was rather slim and long-bodied, with a slender tentacle trailing from its chin, which, to my surprise, was delicately luminous down its entire length, only the thickened tip showing no light. This very fish we later captured

at the surface at night. *Oneirodes* was a globular little fish, chiefly mouth; from the top of its head sprouted an appendage, the upper half of which bent at right angles to the base, and from the end dangled a tiny light, for all the world like an electric bulb. This hung before the fish as it swam along and presumably attracted the small creatures upon which it fed. Approaching to examine the illumination, they would be engulfed by the gaping mouth, so ridiculously disproportionate to the size of the fish behind it. This, however, is at present pure theory.

A third common source of illumination were the fish belonging to a group known as *Myctophum*. These too are found at considerable depths, while at night we also took them at the surface, sometimes in large numbers. They are spotted all over with brilliant points of light—the sides exhibiting a pattern that varies according to the species, and the lower surface literally ablaze with a display which presumably attracts edible creatures in the same way that the little baited rod of *Oneirodes* lures food.

With every haul of the nets bringing in these and other marvels to be studied, painted, described and classified, it is no wonder that working hours lengthened insensibly, and that the necessity for sleep was but grudgingly admitted. There was too, the ever-present peril of missing something, and Argus himself might have found his equipment unequal to the task of having at least one eye always ready for emergencies. There was a

34 THE *ARCTURUS* ADVENTURE

discouragingly vast expanse of ocean to watch for possible excitement.

ON OCTOBER 8TH, 1492, COLUMBUS TELLS US
"THERE WERE MANY SMALL LAND-BIRDS AND
ONE WAS TAKEN WHICH WAS FLYING TO THE
SOUTH-WEST. . . . ALL NIGHT BIRDS WERE
HEARD PASSING."

This voyage of voyages was thus in the height of the autumn migration southward. When I steamed slowly through the same waters it was late February, too early for the spring migration, yet twice we too saw "small land-birds," once a sparrow of unknown species, and again a robin, which had been blown far from land. The sparrow rested on our deck at dusk and could not be discovered next morning. The robin circled twice, but although hundreds of miles from shore, set bravely out westward without alighting.

Another curious sight which Columbus could not have seen was a gull with jet-black breast and under parts. It so defied all my attempts at identification that I shot it as it soared high over the deck. It proved to be a kittiwake in good condition but with the ventral plumage saturated with oil, into which it must unwittingly have swam. It had fed heartily on the small shrimps and crabs which make their home among the sargassum weed.

ANOTHER ENTRY IN THE LOG OF COLUMBUS:
"THE SEA WAS VERY CALM, FOR WHICH REASON
MANY SAILORS BEGAN TO SWIM. THEY SAW
MANY DORADOS AND OTHER FISH."

In the afternoon of the typical day of which I am writing the *Arcturus* stopped again for the purpose of giving us an opportunity of using the reversing thermometers,—ingenious instruments for obtaining temperatures and samples of water at different depths. The waves had been smoothing out all day and finally it looked possible to take an ocean swim. We had planned that such bathing would be a regular part of the program in this sea where, we had fondly believed, calm waters were the rule, but as none of us had experience in English Channel contests, we had so far gazed on the boisterous waves without enthusiasm. We took instant advantage of the present comparative placidity, and a pilot ladder was unrolled over the side. Down this, those who were unwilling or unable to make a high dive, conservatively descended, and discovered that the placidity, noticed with such satisfaction from the deck, was only comparative.

I swam rapidly away for fifty yards and then turned and gave myself up to a realization of my position in relation to old Mother Earth. A glance around brought a tremendous thrill. The swells were smooth but mountain high, not wave-like but as if the whole horizon were a range of mountains marching majestically toward me. My own movement was negligible; I seemed for a long time to be floating at the bottom of a gigantic ultramarine cone, then slowly and gently to rise—high, high, higher,—until I dominated the *Arcturus* and seemed to approach the drifting clouds overhead.

Yet no matter to what height I was borne, the distant horizon always held another, still more lofty ridge.

These great swells fittingly suited the dramatic location—half-way between America and Africa, actually balanced between Florida and the Sahara. The buoyancy was unbelievable and the difference between swimming in a few feet of salt water and here where there were two or three miles of liquid beneath me, seemed very noticeable.

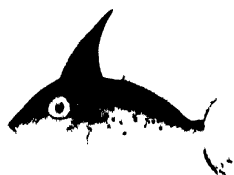
I dived and entered an ultramarine world, with sprigs of amber sargassum weed floating near the ceiling of that world. Tiny fish darted past, and once, even with the dullness of my aquatic vision, I saw a small school vanish from view—a group of timid flyingfish which took to wing and entered the air at sight of my strange appearance. I dived a second time and sank as low as my stored-up breath permitted, and then before I turned and kicked upward, took one long look beneath and tried to imagine that unimaginable world of life down, down in the ever blackening, ever greater pressured depths. No ship or companion was visible and my sense of devastating isolation, of cosmic awe can never again occur with equal force in this life, unless, some day I am able to sense Tomlinson's experience when,

“A Spirit gripped him by the hair
and carried him far away,
Till he heard as the roar of a rain-fed ford
the roar of the Milky Way.”

SCARLET-TAILED TRIGGERFISH

Xanthichthys ringens (LINNÉ)

Various color phases of the same individual. The blue phase is the normal surface color, the white is assumed just before death. (Top figure natural size, the others reduced).



Here then, in the midst of the sea, for a moment, I peered down toward the mid-ocean ridge which Wagner would use to fill up a chink in his continental mosaic; which some would have as the site of old Atlantis, or others strew with the weed-caught wrecks of ancient galleys, medieval ships and modern dreadnaughts. But no theory, whether plausible or incredible, could ever people these depths with beings stranger than those piscine elves and hobgoblins which we were soon to draw up into the light and warmth of our daylight.

I followed the last stream of my life-bubbles to the surface and slowly barged along toward the *Arcturus*. From my fish-eye-view the ship looked enormous, a towering wall of white lifting to show dark, incurving expanses of slimy wood below the water-line, and then plunging down with pile-driver force as though to smash the impelling wave that shot out from the bow in splintered foam.

Getting aboard again was a nice problem in judging time and distance; to grasp the floating ladder on the downward roll and allow the reverse movement to hoist you up without scraping you along the timbers, to employ the next few seconds in climbing high enough so that the next downward roll would dangle you in mid-air instead of sprawling you into the water again; and finally to accomplish all this without losing goodly portions of skin, was a game that required practice to be well done, and luck to be done at all.

As the last swimmer slid damply over the bulwarks to the deck, the fish-horn sounded dismally

from the bridge and an arm over the weather-cloth pointed abeam. We obediently gazed and suddenly two huge-flanged tails heaved up, hung quivering with giant vibrations, hit the surface almost simultaneously with mighty smacks and were gone. Whether we had glimpsed a battle, a courtship, or merely a frolic of two monster whales, we did not know.

Four hundred and thirty-three years ago almost at this very spot, the sailors of Columbus had seen many dorados, and today, at our early dinner, while sunset colors were still reflected in the all-surrounding waters, we heard shouts from the boom-walk, and fled to the deck, to find that a trailing hook had been taken by a big *Coryphaena* or dolphin-fish, or, *como se llama en Español—Dorado*. A vigilant deck-hand and the wireless operator were struggling to hoist it to the swaying, narrow boards. The gleaming fish, fighting gallantly, came out of water; the gaff lifted it over the boom, and just then the ship rolled, the dolphin gave one desperate flop and flung itself off the gaff, and the operator's feet slid out from under him. He fell face down on the steep slope of the foot-way, but under him was the dolphin and both arms were locked about it in a grip of death. We cheered him from the upper deck as he regained his feet and staggered grimly to the bulwarks with his prey. The last of the daylight shone on the green and blue and gold of the dolphin's sides, and we gathered about to admire perhaps a direct descendant of Columbus' fish. The first officer, who had been in charge of

most of our deep-sea hauls, passed by. He paused, glanced at the victim, and remarking casually to no one in particular, "Well, thank God, somebody's caught a *visible* fish," he moved on down the deck.

"THOSE ON THE CARAVEL *Pinta*" SAYS COLUMBUS, "SAW A REED AND A LOG, AND THEY ALSO PICKED UP A STICK WHICH APPEARED TO HAVE BEEN CARVED WITH AN IRON TOOL, A PIECE OF CANE, A PLANT WHICH GROWS ON LAND, AND A BOARD. THE CREW OF THE *Nina* SAW OTHER SIGNS OF LAND."

Such were the signs which cheered the Great Navigator and his men and made them feel that land must be somewhere there below the everlasting western horizon. The same night, in the darkness, the vibrations from a tiny light were detected by the keen eyes of the Admiral himself—the first direct contact with the New World. When we were twelve hundred miles out in the Atlantic, close to Columbus' route, I stood one evening alone watching a new crescent moon hung upside-down in the sky, and wholly obsessed with the vastness and loneliness of the great ocean. Later I went into the library, and turning to the powerful radio which had been given me, I idly put it into commission.

Instantly there arose a confused sound of instruments which, almost at once, cleared into a full orchestra, in a concert hall in far distant Pittsburgh, playing "Hands across the Sea." Another

half-inch twist and the room was filled with the liquid tone of some unknown Señorita, singing a song of old Madrid in a far-off Spanish cabaret. It was beyond words miraculous to realize that the whole atmosphere above this mighty ocean, so clear and silent in the moonlight of the Sargasso Sea, was vibrant with untold hosts of melodies streaming past from all over the world. I shut off the radio, went on deck far up into the bow, and looked down into the silvered water, my eyes straining as had those of Columbus. I knew then that all the marvel of our modern inventions, all knowledge of the restless millions of people on the distant continents could arouse no emotion equal to his, when, four centuries ago, the first glimpse of that tiny light came across the water.

CHAPTER II

WHERE CURRENTS RIP

WHY has no one ever written of walls and fences? They are full of interest, and when considered from the point of view of the fences themselves, rather than what they confine, they are very new and fertile subjects. There are invisible fences, like the miles of wire on our western plains which shine out only near sunset, until the autumn tumble-weed makes them conspicuous all day, piling up fluffy but visible barriers. The stone fences of New England seem indestructible, but when the hands that built them are quiet or have gone cityward, they drop, stone by stone, to the ground and are scattered again. But even then their paths can be traced for years by the lines of cedars and cherries, bird-planted, carried there by the wings of hundreds of generations past. There are temporary fences, like the slanting sections which appear at exposed places along railway lines to catch and drift the driving snow; and, still more evanescent, the wooden walls which are erected for the purpose of training police dogs to jump.

We in this country do not know how terrible

fences can be until we have seen the dead-fall bamboo lines of the Bornean Dyaks, which wind up and down hill through the jungle, and each morning are a shambles of pitiful dead things, from moon rats to argus pheasants. And it will be decades before we can ever know the beauty of English wall-trained fruit trees, planted long before we became a nation.

It were easy to think of scores of others, but I wish only to get my mind in the mood of thinking barriers, with all the details cast aside and only the abstract remaining.

Walls can be more than tenuous, they can be actually invisible, as when I once camped by the rim of a great abyss near southern Tibet, up which there poured so steady a wall of wind that I used to lean recklessly far out against it, farther than from where I could possibly recover my balance in the event of its slacking. It was a fool stunt, now that I look back upon it, but it showed me that the air could offer a support like a board.

I am leading up to a wall of water, not the kind which once banked up in the Red Sea, but one that we came on unexpectedly in the Pacific Ocean.

On March twenty-eighth we made the transit of the Panama Canal, and prepared to investigate the life of that part of the Pacific which, though on the Equator, is traversed in a northwesterly direction by the cold Antarctic stream known as the Humboldt Current. This is a reversal of the conditions brought about by the Gulf Stream, and is responsible for many paradoxical facts, such

as the presence of those Antarctic creatures, penguins, living and thriving under what should be the intense heat of the equatorial sun.

Just as in the Atlantic we had started out with the dominant idea of Sargasso Sea in mind, so now in *der Stille Ocean* it was the Humboldt Current that we looked forward to studying. Our memory of two years ago on the *Noma* was still vivid,¹ when the turn of a promontory meant sometimes such a drop in temperature that, even while crossing the Equator, we hastily donned sweaters. A few miles made all the difference in the water, whether it flowed about our bodies comfortably warm as the tropical sun could make it, or whether it met us in our dive with the shock of a New England plunge.

The first three days in the Pacific we could think of only one thing—the glorious smoothness of the ocean. For weeks we had wallowed almost bulwark deep in the Sargasso, with never respite for efficient dredging or trawling, or a chance to walk steadily, sit relaxedly, or think quietly. Here the sun rose day after day on a mirror, or on gentle ripples, and the *Arcturus* pushed quietly and firmly through the ultramarine, fretted here and there with the ripple chains forged by flyingfish tails, or the great splashed stars where a tunny or dolphin leaped. Our night hauls were rich, full of new and exciting treasures, taxing our utmost time and energy to watch, describe and preserve.

¹ Galápagos: World's End, p. 163.

Early on the morning of the third day we were up ready for the Humboldt Current, for new deep sea fish, for wonderful floating things—for anything except what actually came to us. At seven-thirty, after sounding, temperatures, and breakfast, I went on the bridge and saw a very distinct line in the water to the north. The captain said we had been steaming parallel to it since dawn. I had the *Arcturus* turned toward it at once, and found the Sargasso Sea of the Pacific, only in this instance it was a wall of water, against which all the floating jetsam for miles and miles was drifted and held. There came into my mind at once the Humboldt Current, but I soon found that, most astonishingly, that Antarctic river had nothing at all to do with this gigantic Current Rip, which was caused by the coming together of two warm, westwardly flowing streams of water. When we first detected the rip we were in $2^{\circ} 36'$ North Latitude, and 85° West Longitude, which placed us about two hundred miles southeast of Cocos Island.

When I approached within the possibility of more accurate examination, I saw that the line, which stretched from horizon to horizon, extended in a northeast and southwest direction. On our side, the south, the water showed dark and rough, but much lighter and smoother to the north. When the *Arcturus* was at last actually astraddle of the rip, I saw it as a narrow line of foam, zigzagging across the placid sea, with spouting white-caps shooting up through the froth that marked the meeting place of the great ocean currents.

The birds were the most noticeable inhabitants of this world of two dimensions, boobies of several species, stormy petrels, tropic and frigatebirds, soaring or feeding. Still more interesting than these was a flock of about two hundred northern phalaropes, strange little sandpipers which nest in Alaska and spend the entire winter far out of sight of land. These were massed in a close flock and flushed time after time just ahead of the steamer in the line of the rip. When finally they went on ahead for a half mile, they followed exactly every zigzag of the line of foam, keeping precisely to each bend of the denticulation of the current juncture. Twice after this I saw several of the little chaps cheating us of our belief that they never touched land except in the far north to breed, for they were perched on floating logs, picking out edibles from the crevices.

During the last few days we had observed a fair number of sea creatures, but here was a concentration of organisms greater than I have ever seen—the larger dotting the water and making visible its depths, the minute so abundant that in places they were of the consistency of soup. We had to give up trawling with the silk nets for two reasons; in the first place the throw and shift of the currents was so strong hereabouts that the nets and lines were often swept beneath the keel and in dangerous proximity to the propellers. Again, the amount of floating organisms was so great that the silk bags would fill immediately with a weight which strained them to the utmost. A

few scoops with a hand net would collect a mass equal to a long haul through average ocean water.

When I realized to the full the significance of this tremendous phenomenon, I determined to spend a day or two in following the current rip slowly along, studying it as I went. Within a half hour of our reaching it a mighty school of dolphins came down the line, five or six hundred of them, leaping and playing, jumping high into the air, and presumably feeding as they went. For a while their long-drawn-out front, with its continual spouts of spray thrown high in air, looked like a counter current rip, extending in another direction.

For the first time I fully appreciated the advantages of the many strange contrivances I had invented for reaching down or getting close to the water. The pulpit now came in for constant use. In the Atlantic we had usually to keep this affair high above the surface, for the *Arcturus* would plunge and dip her nose so deeply that unless it was swung well up, one ran the danger of being washed out of it. Here the comfortably roomy iron flooring with its waist-high railing extending all around it, was lowered until it was almost at the surface, and here with harpoon or dip-net one stood, approximating the wonderful experience of St. Peter, at least in the early stage of his experiment.

From the stern of the vessel the crew had a veritable portière of hand lines baited for fish of all sizes from triggers to sharks. The gang-

way was lowered until the bottom step was awash, while on the port side, the boom-walk was perhaps of all the most popular and valuable point of vantage. Here we could walk easily along the double duck boards, with a guardian boom on each side, to a distance of thirty feet beyond the side of the ship, and lie down or sit or stand, with as excellent a view of all that went on in the water beneath as could be imagined.

I was astonished even before we reached the rip, to see logs of wood passing, many of them covered with an ivory mosaic of barnacles. Our pent-up energy had to find a vent in some way, and when I called out for volunteers to help haul one of the logs from the water up to the boom-walk, the instantaneous response together with the violence of the several attempts, warned me that this was the time and place where the static energy of my crowd was about to become transformed into muscular action. There is no precedent to be followed in the matter of getting floating logs on to boom-walks and so to the deck, and doing so without losing the inhabitants of the log. In fact, there had never been a boom-walk before, so it was anybody's method, failure or solution. Six of us began enthusiastically to collect the first log in the world ever thus to be gathered. As instrument after instrument proved inadequate, more material was shouted for and over the rail there poured a barrage of wire loops, boat-hooks, gaffs, nets and bags. One of the most enthusiastic of the loggers dropped two poles, a gaff, a bag and a net over-

board and then went over himself to salvage what he could. Meanwhile we had roped and wired the great mass, and by hanging by our knees and heaving willingly but all at different times, we got it up at last, dripping water, fish and crabs, and with a final shove heaved it over the rail to the deck.

I was afraid that all of the small people in the wooden sanctuary must have fallen out from the shaking and the banging to which the log had been subjected, but little did I know the clinging powers of these small beings. In the case of this particular log they might all have come of the race of Jumblies, for boring worms had been at work on it, perhaps when it was a pile of some far distant wharf, and by their activities had made half of it a veritable sieve. The long list of passengers would be out of place here; suffice it to say that we got fifty-four species from this single log. No sooner had we dumped it on the deck, than those of its inhabitants who objected most to fresh air began dropping off, first a five-inch trigger fish, followed by some younger brothers, and later a swarm of little blennies to whom the log must have meant much. For these fish are on their way to become quadrupeds of sorts, and are ordinarily never found far from solid shore. These belonged on the coast of Mexico, ranging as far south as Panama, which gave us at once a clue as to the origin of the current flotsam. They skipped alertly about on the deck, going where they wished, not, as with most fish out of water, where their flops took them.



FIG 12.—LIFE OF THE CURPENT RIP
Frigatebirds, Boobies, Gulls, Petrels, Dolphins, Sharks, and other fish

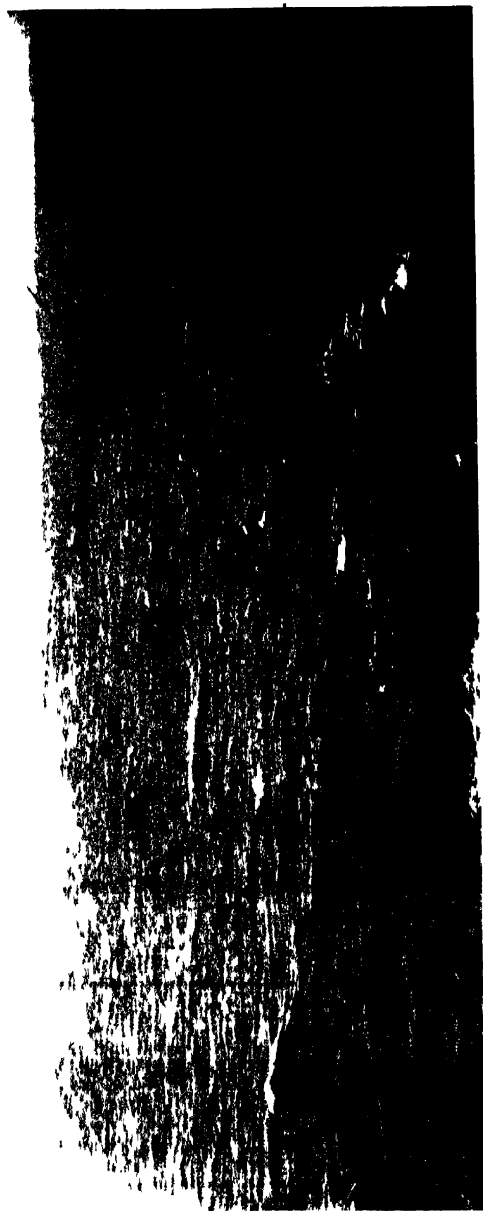


FIG. 13—CURRENT RUN
Encountered three days out from Panama

At first glance they appeared black, but on close examination showed a glory of scarlet spots all over the head and pectorals, and maroon and sage broken bands on the body, with the median fins variegated yellow and red. Over the eyes were two long, lemon filaments, and a blood-colored Y-filament at the nostrils. They looked intelligently about with their pop eyes, and lived through vicissitudes which destroyed all other fish.

Crabs in multitudes crept about or were picked out of crevices and water-worn cracks. Some were pale olive-gray, irregularly mottled with maroon, looking like bright-colored conglomerate rocks. On the legs were sea-green swimming fringes. The ivory-white under parts never showed, as the crabs always scurried about with bodies held close to their pelagic island. Some of the forward-bent abdomens were cupped about a large mass of chocolate spawn. Other species of crabs were deep, Dutch porcelain blue, and one dark chocolate one had a big transverse rectangle of white like the sargassum crabs.

The log reminded me of a large piece of fossil rock, such as I used painstakingly to hammer out of New Jersey quarries. Wherever a knot had rotted away, or a teredo worm had gnawed out a tunnel, the interstice or crevice was filled up by an animal which fitted as if it had been poured in, a kind of living fossil embedded in the dead wood. Especially was this true of enormous worms countersunk in every possible crack. These were seven and eight inches in length, with nu-

merous bunches of curly medusa heads of reddish tentacles above, and dozens of brush-like tufts of white spines.

Again and again I was impressed with one outstanding feature of the Current Rip, this uncharted zoölogists' paradise—the narrowness of its limits and the sharpness with which these limits were defined. It was a world, not of two, but to all intents and purposes, of a single plane—length. From first to last we followed its course along a hundred miles, and yet ten yards on either side of the central line of foam, the water was almost barren of life. The thread-like artery of the currents' juncture seethed with organisms—literally billions of living creatures, clinging to its erratic angles as though magnetized. The floating, drifting world of ocean life was, of course, irresistibly swept there, and this life alone would have made it worth a year's study. There is no stronger attraction in life, however, than food, and here was food, manna, ambrosia, in stupendous quantity, to be had for the taking. Somehow the news must have spread far and wide, over and through the great lake-like expanse of this part of the Pacific. As each group and individual sensed the happening, another and still another one or one thousand, a little farther away, saw the eager start and in turn started. I can in no other way account for the infinite number of fish and organisms other than the helplessly drifted plankton which filled all this rip. It seemed as if as great an area must have been depleted of its larger, self-swimming, dominant

creatures, as of the lesser, wind-driven, current-swept folk.

These last helpless ones have been given the name plankton, which is appropriate, for when the Greeks used it, they meant Wanderer. Here we saw what must have amounted to many, many tons of these minute beings—diminutive crustaceans, both adult and larval, the myriad species of jellyfish and pelagic mollusks, worms, larval fishes, single-celled animals such as those which light up the sea at night, and my jolly little friends, the flying snails. Where these are gathered together in numbers, there will the self-determined fish be, tiny little chaps who dash about and feed upon the living soup of the sea. These in turn, attract middle-sized fish, and these still larger ones. This would seem like a straight line—a linear chain of life, but it is, in reality, a great segment of a curve, the circle being completed when one of the great marauders dies, and furnishes food, not only for his former victims, but for the minute creatures that he would have disdained as nourishment.

Although compressed within so narrow a longitudinal area, yet the slow procession of the wonderful fauna was far from uniform. Whether we use the simile of corpuscles tumbling along a stream of blood, or some less apt memory, the nodes in the line of life were the logs and other débris. The number and diversity of these were beyond belief, and I longed for a botanist to identify them all and perhaps to tell from what exact coastal or river forest or jungle they had drifted. Of one

thing I was certain—all were tropical. None had come from more temperate regions, borne along on that Humboldt Current of which as yet we had found no trace. I remembered the sentence I had written in my Galápagos book, sponsoring the continental origin of that Archipelago:

“As with my theory of the origin of flight through *Tetrapteryx* and my classification of Phasianidae by tail moult, so with all my points of view which in our present state of knowledge must be wholly or in part theories, I hold them in readiness to be relinquished at the first hint of better proof on the opposite side,”

and wondered whether this Current Rip must be the opening wedge to relinquishment. It was powerful evidence for the opposition—those who held that the Galápagos had always been isolated islands, planted and populated by the accidents of drifting seeds and transported insects, birds and reptiles. Here I was, just about half-way between the outermost headland of Panama, and the outlying island of the Galápagos, and, passing slowly but steadily to the southwest, was floating jetsam of a size sufficient to support any member of the Galápagos fauna, jetsam laden also with seeds and sprouted plants enough to suit an island-favoring botanist. Within an hour, there passed log after log, sticks and solid pieces of wood, besides three bits of wreckage from ships. I noticed a forty-foot *Cecropia*, six inches through, bamboos up to five inches diameter, and soft, pine-like wood,

besides sections of palm trunks and a cocoanut in the husk—all rotten, all alive with living creatures catching a ride. During my stay, I made a list of thirty-eight species of trees, plants and seeds, and of thirty-two of whose identification I could be reasonably certain, not a single one is to be found in an exhaustive list of the flora of the Galápagos. Either this marvellous Current Rip is a recent phenomenon, dependent in some way upon the inexplicable shifting or absence of the true Humboldt Current, or its course, beyond where I could see it, was deflected. Both, indeed, may have been true, but of the former I have no means of judging. To anticipate our movements, I may state that after remaining and studying the rip for two full days and nights, I followed it for several score miles, and, as I shall narrate, saw it turn steadily northward, until, at $2^{\circ} 8'$ North Latitude, and $86^{\circ} 4'$ West Longitude it was headed west by north, by one-quarter north. If it only maintained this direction it would clear the northernmost island of the main group of the Galápagos by one hundred and fifty miles, and even the most northern of all, the isolated speck of Culpepper, would be a full hundred miles south of the influence of this log-rolling current wall. So, at least from this angle, my theory is still perfectly tenable.

Four large sharks loitered around the ship in most deliberate fashion, and there was a wild scurry for harpoons. John Tee-Van, descending to the pulpit, brandished one of the weapons to

an accompaniment of jeers from his observers. They discovered, however, that it is not safe to predict failure merely from the premise that the venturer is an amateur. With as much precision as though he had made a life-long study of harpooning, he hurled the spear not only into, but straight through the shark and the half-hour struggle to hold the creature was sufficiently exciting to satisfy the most exigent of big-game fishermen.

The other three sharks were not alarmed by the fate of the first. They lingered on the scene of his disaster, and from the boom we paid out string with pieces of meat for bait. They came as easily to this toll as a donkey following a proffered carrot and by pulling in the tempting morsel two feet in front of the eager blunt snouts, we brought them to the surface directly under our feet, so that we could watch the movements of the brilliant blue pilotfish, that, with uncanny prescience, anticipated every movement of their huge patrons. One of the big fellows had three of these little satellites that unfailingly held their formation, one just above his head, the other two in perfect alignment a few inches in front of his jaws. So exactly synchronized are the movements of such a marine galaxy, that it is impossible to tell whether the shark follows the pilotfish, or the pilotfish the shark. It is evidently a profitable arrangement for the pilots, since we meet with few cases of philanthropy in marine life, and whether they actually lead the sharks to food, or are merely hopeful

hangers-on, at any rate they must benefit by the crumbs that fall from the sea-wolves' table.

The sharks had even more literal hangers-on, in the persons of the shark suckers. The big fish can seldom be lonely, for there is scarcely a shark to be found without at least one of these pseudo-parasitic attendants, known as *Remora* or *Echeneis*. Clinging with the great sucker which has, in some way, evolved from the dorsal fin, these strange creatures can slip at will over the whole of the shark's body. When their host is hooked, they cling until the very moment when he is drawn into the air. Then, realizing that the worst has definitely happened, with an admirable expediency they desert, not the sinking, but the rising ship, and hurry away to find some less unlucky means of transport, whether shark, or, it may be, some other great fish or a turtle. We took two *Remora* with hook and line, which is rather unusual.

Late in the afternoon of our first day in the rip when we had stopped in order to take temperatures, I was looking down from the bridge when I suddenly saw a sea snake swimming in small circles and drifting slowly along. It recalled the last meeting I had with these real sea serpents—when I balanced in the bow of a sampan in the swift running tide of Penang. A Chinaman steadied the boat for me with his long sweeps, while I dipped up various desirable creatures as they swept past on the current. As I had no bottle or bag of sufficient size I carefully avoided the sea snakes which were swimming past, literally

in hundreds. They were brilliant in color, olive green above, with many, broad, yellow cross bands, about as protectively colored as yellow daisy blossoms in a green field.

I knew they were also found in the eastern Pacific but had not seen them here before, and I keenly wished to capture this one. Two of our small boats which were overside, were too far away to understand our frantic signals, so, handicapped by the thermometer line being out, all we could do was to hope that the reptile would drift down on the ship. Luck was with us, for while we watched breathlessly, our first sea snake writhed so close under the boom-walk that we were able to scoop it up with a long-handled net. Before the net closed over it, it seemed to be biting at a part of the body where I could see a small white spot.

I seized it back of the head and dropped it into an aquarium, taking considerable care in the process as these are as poisonous as any of the venomous terrestrial species. It did not struggle much or seem to have the strength which a snake of its size—almost three feet long—should have. From the water of the tank it lifted only the head and neck, and showed no interest in its new environment. This lethargy was doubtless due to two severe bites which it had received from some foe. At one of these it had itself been striking, probably in unreasoning irritation at the pain. It had several patches of good-sized barnacles along the body, and some small ones even on the crown and

chin. Nothing with a scaly or a hard skin seems safe from these omnipresent crustaceans. I once thought that after they had grown for a time, they must set up a certain amount of irritation, but I have removed barnacles of good size from fish, without finding any trace of lesions. Here too, when I scraped a few off, neither in surface or pigment was there any alteration noticeable from the normal.

I had this *Hydrus* painted, photographed, and his method of swimming studied, then chloroformed him to put him out of his misery. He had been feeding on two young *Coryphænas*—the dolphin-fish of the ancients, which we found so abundant hereabouts.

This individual was quite as brilliant as my Malay species, but absolutely unlike it in pattern. The dorsal third was black, and the ventral surface and much of the lower sides olive-green. Between the two colors ran a broad band of bright chrome yellow. On the long, flattened tail, this latter tint dominated as a background, over which were scattered a number of large spots and imperfect bands of black.

Besides the sharp keel to which the body narrowed below, and the paddle-like tail, these snakes are so intimately associated with an aquatic life that they cannot survive protracted removal from it. Why this is, no one has had sufficient curiosity to ascertain. Its breeding habits are said to be like those of the seal, as it is viviparous, and goes ashore to bring forth its young in the crevice of some

great boulder. A large female was once found in such a place, coiled about a score of young, each of which was two feet in length. We caught two more snakes in the Current Rip, and saw a number of others which dived at our approach. Without exception all we caught or saw were parasitized by the barnacles, one having twenty-seven clumps. These were all of one species, stalked, the shell being a delicate maroon with two Y-shaped white markings (*Conchoderma virgatum*). When I had several snakes for comparison I saw that the tail pattern is not only wholly individual, differing in each snake, but the pattern varies on the two sides of the tail in the same individual reptile.

I started a trawl with several metre nets at various depths, and leaving directions for the *Arcturus* to revolve in a five-mile circle, I went overboard with John Tee-Van in a small boat and for several hours we rowed about in this astonishing longitudinal maelstrom. I cannot recall having ever seen so many living creatures in so limited an area in all my life. In the distance dolphins still splashed and sighed, boobies whistled by and dived like plummets, gulls and frigatebirds picked up bits of their choice with graceful delicacy, now and then a turtle drifted past, or dived and watched us from beneath our keel.

Sharks occasionally swam by, and twice, by intention or accident, one bumped into our skiff. Later in the afternoon when Dr. Gregofy was out, a big shark followed his boat persistently, circling often, and repeatedly bumped so hard against the



FIG. 14 —GASTROD

An ultramarine sea-slug without a shell, lying at the surface



FIG. 15 —PAPER NAUTILUS

A cousin of the Octopus which lives in a delicate, tissue paper shell

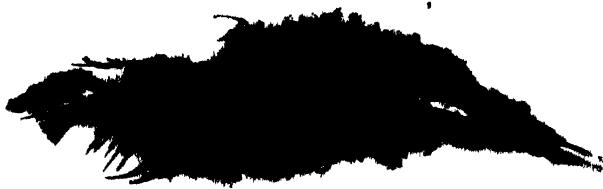


FIG. 16 EGGS OF THE INSECT *Halobates*

The Water Strider of mid ocean lays its eggs on the floating feathers which have fallen from the wings of Gulls and Boobies

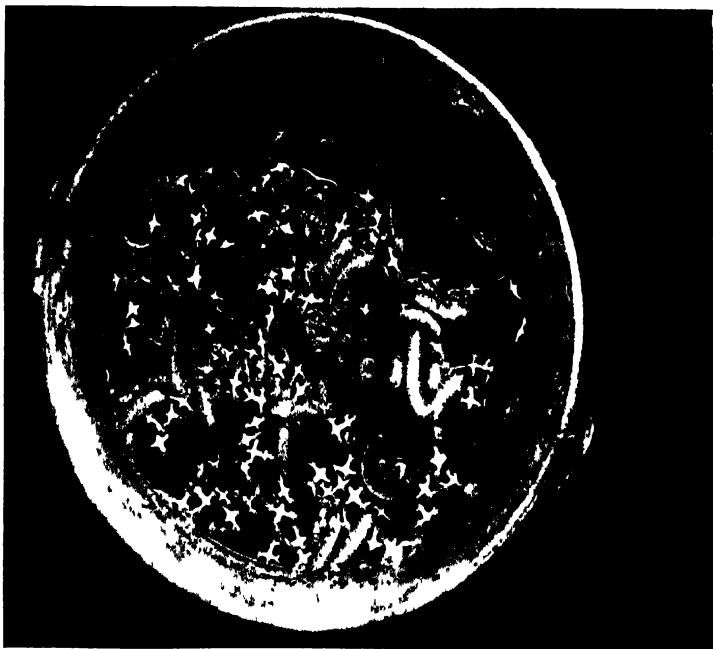


FIG. 17 LIFE OF THE CURRENT RIP

Thousands of living creatures taken with a single scoop of this tub. Most distinct are Jelly fish and Floating Snails. *Porpita Glauca* and *Lanthina*

boat that they were rocked and jarred, and not having even a boat-hook, they began to row back toward the ship. I never heard of such a happening before.

What looked like oval, thick, greenish cigars were floating pelagic anemones, mouth down. At the top a small group of white bubbles—the float—then a circular, dark-green, caterpillar-like body mass, below this a ring of numerous, short, white tentacles, and finally, at the bottom, the expanse of greyish tissue about the mouth. They looked like strange swollen green acorns, with a white stem base and white cup.

Although I have said it before, I must reiterate that the teeming amount of life was unbelievable. Two dips with a butterfly net yielded half a pail of organisms. In one place the water for ten square yards was tinged with deep purple, thousands upon thousands of tiny salpas, each with its large nucleus. The most consistently abundant things wherever we rowed were uncounted myriads of small, rounded, pale spheres, which proved to be the eggs of some unknown species of mollusk.

The strictly surface life was as teeming as that beneath. In the bubbles and spray strung out along the rip were hosts of oblong patches of finer froth, and suspended from one end of this, was always a beautiful purple-shelled *Ianthina* snail. Almost as numerous, and often in solid masses, hundreds of the strange tufted nudibranch, *Glaucus*—dark ultramarine above, shading into mother-of-pearl on the arms, and to ivory white below,

looked like an azure-fringed frog, or some distorted fleurs-de-lis armorial bearing.

Porpita was abundant—those little floating colonies of animals, which I have seen even off the New England coast. At a distance they look like either quarters or silver dollars, according to age, but when I sit down in front of one floating in a glass dish, descriptions and similes pall. On my laboratory table is a beauty with a disk two inches across. I have seen unbelievably minute crystals of some rare mineral, or a thousand beams of sunlight radiating over still water which reminded me of this, but the delicacy of color and pattern are beyond all verbal or written appreciation. The center is yellowish gold, and from here to the periphery, about one hundred and fifty lines radiate and undulate. It is crenulated and waved, and the pale blue and dull yellow are inextricably mingled. The broad margin is deep, deep blue, and outside there are three to five ranks of delicate tentacles. Their long stems are beryl blue, while the rounded beads which double-line the tips are of the darkest ultramarine. Such is a hint of the beauty of one mote among the trillions on every side.

Near the side of the skiff I saw a small white creature dart away, spread four wings with a black spot in the center of the hinder pair, rise and fly for a yard, then drop, and again make a short flight. It was so like a butterfly that for a moment I was too astonished to move. Then I called out, pointed to the tiny flyingfish and my companion

caught it. If it had kept quiet we should never have seen it among the spots of foam. Putting one's hand down into the water was to feel a host of creatures, some visible, others not to be seen until they crashed on the vision in a dazzle of iridescence.

In some old magazine of natural history there is a report of the eggs of *Halobates*, the water striders which live on every ocean, being found on a floating feather, but, as far as I know, there has never been a reconfirmation of this. In the course of our association with the Current Rip we found, not one, but seven examples of it. As we were rowing slowly about, I saw a long white wing feather of a booby, which seemed to have some strange encrustation. I scooped it up and found that three-fourths of the vane was clotted with a rust-colored mass of ova. I did not stop to examine this carefully at the time, as new specimens were passing at every moment, but put it in a small aquarium of running water. The next morning both this aquarium and the four succeeding ones were a maze of tiny skating figures, and the distended stomachs of the small fish in two of the tanks, showed that others than myself appreciated this discovery of hatching *Halobates*. I found that there were at least twenty thousand eggs on one feather, undoubtedly representing the united efforts of many females. Some of the eggs seemed newly laid and these would often overlap others that held large embryos. Under the lens they looked like a mass of tiny grains of rice, some

tan, some orange in color. Two more feathers were taken later, and four large ones were seen passing, all heavily laden with the hemipteran ova. Outside the rip I noticed four additional lots, in the course of this trip, three on feathers and one on a piece of wood. Nine out of the ten feathers were white ones from the wings of boobies, the tenth was brown, probably from an immature bird of the same group.

From the small boat on the same day we were fortunate enough to catch in a pail one of the enormous, smoky-grey egg masses, a dozen of which I had seen floating by the ship. In a glass aquarium it looked like some loose-textured sponge, with great openings here and there like the vacuoles in a sponge. The microscope showed vast numbers of small fish eggs—a small bit teased into a watch glass contained twelve hundred and seventy-six. I was greatly disappointed at not being able to rear some of these, but the aquarium pump went wrong at this time and these, among other specimens, were destroyed. Our curatrix of larval fish had better luck with a few in a dish and kept some alive for seven days. Certain characters seemed to stamp them as young *Coryphana*, but we could never be quite certain.

The dominating fish of the whole Current Rip were unquestionably young amber-jacks or yellow-tails, the well-known game fish of the Pacific coast. These were present in schools of tens of thousands, each school keeping in dense formation, and moving with that inexplicable unanimity which has

made me so often use the expression, the spirit of the flock or colony, herd or school. There would sometimes be several hundred of these fish massed under the keel of our little boat as we rowed about. They refused all bait and it was with great difficulty that we secured two or three specimens.

We had been less than a week out from New York when we discovered the value of the gangway as an adjunct to night fishing, and although we had made use of this on all occasions, we had no hint of its real possibilities until now. At dusk, when the *Arcturus* was safe cradled between the two pressing walls of water, I had two clusters of electric lights lowered to the last steps of the gangway and focussed down upon a twenty-foot circle of water. To sit and watch the gradual concentration of the ocean life attracted by the light, was to have a very wonderful experience.

The first arrivals were *Halobates*—the water-striders of the sea. Two years before I had found their newly hatched young in thousands close to the shore of Indefatigable,¹ and today I had verified the secret of their cradles. A hundred soon gathered and covered the surface of the lighted area with a maze of shooting lines.

No amber-jack came, but *Coryphæna* was there in numbers, and we caught thirty or forty, all less than a foot in length, reflecting every imaginable color. This marked the beginning of the inevitable chain of reactions—first the small fry and then the small fish; next the outposts of the mighty army

¹ Galápagos: World's End, pp. 88-86.

of the middle-sized—the mid-links, feeding upon and fed on. After the *Coryphæna* and others of their kind had played about for a while, faint, ghostly shapes began to appear far, far down, and soon a shark rose to the surface, and nosed about to see what this new thing might have in store in the way of crippled or dead. The most exciting visitors—and they came in all sizes and colors—were the squids. In and out weaved little two-inch chaps, pursuing fish of equal size with such speed and ferocity, that when one leaped, they both leaped out of water. My net would slip under a scarlet squid, and in the length of time it took to lift it to my eyes, the net appeared empty, until a slight sag in the mesh showed where there lay a squid of pearly whiteness.

A six-inch species placed in the big tank gave a most marvellous exhibition. From side to side it darted so swiftly that the eye could scarcely follow, and at the end of each dart, as it brought up against the glass side, it was a different squid—first scarlet, then salmon, rose, scarlet again, pink and the white of a moonstone.

We had to have a clearing house, or rather a clouding house aquarium for newly caught squid, in which, as soon as deposited, they could empty their sepia bags. A big squid three feet long which we harpooned, ejected an enormous quantity, not sepia, but opaque, bluish brown ink, that gave off reddish bronze reflections like the skin of his body.

If in the permanent aquarium with the larger squid, there remained by chance a hapless fish, a mo-

ment after the first frenzy passed, the squid went for it like a flash of lightning, seized it, and hugging it close to the heart of the horrid circle of arms, began to devour it, always beginning at the throat.

A passing swell, coming out of the black night, would fill the lighted circle with a *mêlée* of jetsam—porpita, ocyropsis, ianthinas and salpa, which, if you do not know them by these names does not matter, for if you will allow your imagination full play, and try to think to what strange and beautiful beings such names might apply, your mental images will yet fall short of the strangeness and beauty of the reality.

At a critical moment of the fishing, when we were keyed up for something great and weird, there flew into the glare a fluttering school of the little, snowy-winged, butterfly flyingfish. A villainous atom of a blood-red squid shot forward at them and three flew straight into my net. Large pelagic crabs came and went, wine-colored, with purple swimming legs, eyes wavering on long stalks, and long, many-toothed claws, waiting for what the squids did not get. Half-beaks shot across the circle, as rapidly as the squids, and half-transparent fishlets showed first one, then another outline as the light and waves partly revealed them. The greatest surprise was when a very large silver hatchet fish, *Argyropelecus*, floated into view. It was dying, as it had been badly bitten by some creature, but it was the first and only time I ever saw this richly luminous fish at the surface of the sea. Not many miles away I was later to take

one in a tow net at three hundred fathoms, but the center of their distribution seems to be in still colder, darker water, about five hundred fathoms, two-thirds of a mile down.

Nature loves contrasts, and close on the passing of the flock of white-winged flyingfish, a great creamy white shape appeared and vanished again far down in the translucent depths. Then it rose head first, a large shark as we thought, heading straight for the gangway. Just before it broke water, someone shrieked "It's a squid!" and at the word half the monster shot into the air, his wriggling tentacles seeming to reach for the row of legs that dangled from the ladder. A chorus of excited shouts arose from the four of us who were on the spot, an inadequate harpoon splashed harmlessly beside him, and the creature dashed backward and sank out of sight. He was different from the other lesser squids, not only in size and shape, but in color, being a pale pinkish tan wholly unlike what any of the others could achieve by whatsoever combination of their chromatophores. Hardly had we gasped out our joy, when in exactly the same spot he appeared again, and went through the same manœuvres, springing from the water as though propelled by a submarine cannon. Allowing for every illusion of night, water, light and excitement, the most conservative estimate placed his length at eight feet, and the width of his body at nearly two. None of us will ever forget the spectacle of that long, torpedo body shooting out of the froth of the rip, the snaky, outreaching arms

beaded with big vacuum cups, and above all, the huge disks of eyes which glowed like silver plates in the tan flesh.

The afternoon of our last day, the life of the rip seemed, if anything, to have increased. Full grown *Coryphæna* played about, and now and then we hooked one, but they were usually too strong and heavy to be played successfully from the boom or the deck. Seen just beneath the water, they were a blaze of color—the body emerald, the pectorals turquoise and the tail clear yellow gold. Sea snakes undulated past, their golden spotted tails flashing out as they turned and looked up at us. Great turtles drifted along, as motionless and as barnacled as the logs about them. A dolphin-fish leaped over one and darted about it, but the turtle looked only at us. Another *Coryphæna* dashed by with a great piece bitten out of its shoulder. I cannot imagine what enemies these high-powered engines of the sea can have, except real dolphins, unless they wage battle with one another.

From the deck, looking directly down, we could watch clearly the fish which crowded beneath every log, or stick or nut. Big triggerfish, over a foot in length, often lie flat on the logs, half out of the water, or jam themselves into crevices in attitudes most astounding for a fish. Once a twelve-foot hammerheaded shark swam slowly around the whole ship.

We dared not go below for a moment, and begrudged every minute at meals, for fear we should

miss some of the absorbing tableaux and exciting events which were constantly passing on every side. Always the key to the meaning of the actions and reactions lay in the complex inter-relationships of all these myriads of living beings. We were trawling slowly ahead, and bore down on a small log on which was perched a booby, a big fellow in brown, with pink bill and greenish feet and legs. Just before our bow upset his raft, he ejected three fish, each at least eight inches long, and so recently swallowed that they seemed still living. Immediately every fish under the log dashed at this sudden appearance of food, and for yards around the excitement spread and spread. Meanwhile the booby, lightened by the discarded ballast, flew off, spattering the water with his great webs for a few yards, and followed eagerly a little way by the hammerhead and several dolphin-fish.

Just after this we caught a *Coryphæna* from the boom-walk which weighed thirty-two pounds and as completely disintegrated the white sunlight to our eyes as any prism which ever reflected a spectrum. From its gills I took twenty-five parasitic crustaceans, of which half were in turn parasitized by pinkish goose barnacles. And this great fish had been feeding on the most beautiful sea-shell in the world—a dozen paper nautilus, all uncrushed and unharmed, with their little argonaut owners.

Three times on this last day great areas of the water were colored a deep purple by incredible numbers of delicate jellyfish, and again a yellow stain was spread over a hundred yards of surface,

BUTTERFLYING FISH
Cypselurus furcatus (MITCHILL)

Young specimen
(Twice natural size)



—billions and trillions of microscopic creatures manifest to us only by a tint. I fished up a many-branched bamboo tree-top about twelve feet long, which, for many seasons, must have waved in the breeze fifty feet in the air in some distant jungle. Now its slender side branches all seemed in full flower, tipped and beaded with a myriad ivory barnacle cups, swaying on their little stems, the whole looking for all the world like a gigantic spray from a Japanese cherry-tree in April.

As to the physical reactions of my great Current Rip, at five-thirty on the afternoon of the first day we steamed into the center, faced eastward, which was up wind and up current, and there lay all night. During that time we drifted eleven miles to the west, the current being about one and three-tenths knots, and we turned completely around twice, but never left the heart of the rip. We rolled slightly all night and three times I was awakened by what sounded like breakers, which proved to be the rip near by, the sea in the distance showing calm and quiet in the moonlight.

During two days we repeated this experience three times, with the invariable result of swinging up wind and current, then vibrating slightly from side to side as first one, then the other current pushed us toward the dead center. I tested the temperature a quarter of a mile on each side of the central line, and found that the southern current was four degrees colder at the surface, and two degrees as far down as five hundred metres. The current on the south side flowed about two and

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a half knots, and that on the northern side one and one-half knots.

The orientation of our mean position in the rip was,

South from Cocos—210 miles

Southwest from Panama—400 miles

West from Ecuador—340 miles

Northeast from Tower Island—300 miles

The trend of the rip on April first in $2^{\circ} 5'$ North Latitude, and $85^{\circ} 53'$ West Longitude, was southwest by west one-half west (242), and by the afternoon of April second in $2^{\circ} 8'$ North Latitude, and $86^{\circ} 4'$ West Longitude, had swung to west by north one-half north (285), a shift of forty-two degrees to the northward.

The last view I had of the rip was a dramatic and memorable one; five great, red-footed boobies perched close together on a floating log. Four were in the white adult plumage, and the fifth still in immature brown. They paid no attention to us, although they were less than fifty feet away, doubtless considering the *Arcturus* merely a log of greater size, and us, marooned fellow birds. As I watched, the fin of a gigantic shark circled close to the log, passing completely around it four times. The birds paid no more attention to this than to us. Slowly they drifted past and the sunset stained their feathers a delicate salmon; then night and distance swallowed them up, and I shall never know more, either of the satisfying of the appetite of the shark, nor the slumber and dreams of the sea birds.

CHAPTER III

WITH HELMET AND HOSE

I AM twenty feet under water with a huge copper helmet on my head, tilting with my trident against an olive-green grouper over a yard long, who is much too fearless and inquisitive for my liking. Not until I have pricked him sharply with the grains does he leave off nosing my legs with his mean jaws and efficient teeth. It suddenly occurs to me how knightlike I am as far as the metal casque goes, and then in spite of the strange world all about, my mind goes back to the long-ago Christmases when a new-published Henty book was an invariable and almost the best gift. I instantly know that if ever I succeed in shackling these divings to mere, awkward words it must be called "With Helmet and Hose," and if any modern boy, grown-up or gentle reader does not know why, explanations will do no good.

I wish I could credit my present passionate enthusiasm for diving beneath strange tropical waters to a life-long suppressed desire—an *idée fixe* which would not be gainsaid. But unfortunately this is not so. My only excuse is that I suffer intermit-

tently from what my artist once offered as a definition of a monkey, a desire to be somewhere else than I am.

Considering carefully this whirling ball of mud upon which I found myself, I read in books and saw pictures of jungles and deserts, and my desire to see them was just a little stronger than the many obstacles between; I had breathed the air and watched birds fly for an unconscionable number of years before I began my first wobbly taxi-ing across a flying field. Since then I have left the earth under pleasant and unpleasant conditions over three hundred times, and, except twice, returned safely.

Without shame I confess that I have lain awake nights and spent innumerable hours of my life in gazing at the moon and planets—nay, even at the Small Magellanic Cloud with desire and longing, for if one wishes to visit inter-stellar space, one might as well hold the thought of a passage on Tomlinson's route as on a measurable moon trip. Up to the present, twenty-two thousand feet is as far as I have been able to rise above solid ground.

Another realm which has always seemed as remote as the moon is the depth of the ocean. My reading and wishing never took any concrete, definite direction until the trip I made to the Galápagos on the *Noma*. Then I first realized the glories and desirability of the submarine world. This at once encouraged and then disheartened me—the encouragement coming from the ease of diving from a boat or a pier and watching for a brief moment the fish and sea-things, simultaneously with the

realization of the futility of such a brief, blurred glimpse.

I inspected a number of diver's outfits one day and found nothing tempting in the enormously cumbersome suits. Then, just before I sailed on the *Arcturus*, I bought my helmet. The paraphernalia accompanying it were so simple that I doubted its efficiency, but at least it was an effort in the right direction of investigation of a new world.

During the first part of the *Arcturus* adventure the sea was too rough to think of using it, even a few feet below the gangway, but when we moored close under the cliffs of Darwin Bay at Tower Island—our old Galápagos anchorage—I brought up the box from the hold and unlimbered the diving apparatus. The helmet was a big, conical affair of copper, made to rest on the shoulders, with a hose connection on the right side and two oblique windows in front. Around the bottom extended a flange on which four flattened pieces of lead were hung, each weighing ten pounds. This made a total weight of sixty pounds for the entire thing. The hose, which was of the ordinary common or garden variety, was attached at one end to the helmet and at the other to a double-action automobile pump, which screwed to a board, and was operated by a long iron lever, pushed back and forth. Almost at once we elaborated a method of operation which was so simple and satisfactory, even to the slightest details, that no change was necessary after weeks and months of use.

Our regular mode of diving is as follows: We start out from the *Arcturus* in a flat-bottomed boat which has a square, eighteen-inch glass set in the bottom amidships. My regular diving crew is John Tee-Van and Ruth Rose and we three dived in many and in strange places. To the stern is fastened a long, metal Jacob's-ladder, rolled up when not in use. We are towed or we row to the shore, preferably to the base of cliffs or steep rocks, as that affords considerable depth close inshore and rocky places are beloved by hosts of fish. We anchor as close to the cliffs as is safe, and roll out the ladder, so that it sways in midwater or rests upon the bottom. The pump is in the bow, the handle fixed, and the leather washer carefully screwed in. The hose is cleared of kinks, and is looped, partly overboard. A hand line is tied to the top of the helmet, and the inside of the glass windows is coated with a film of glycerine to prevent the breath of the diver from condensing and so clouding it. The four lead weights are slipped over the flange on the helmet base and all is ready for the diver. A hand water-glass is near for constant lookout for danger, and one or two long-handled harpoons.

In bathing suit I climb down the ladder over the stern, and dip to my neck, being careful not to wet my head. Then John lifts the helmet; I give a last, quick look around, draw a deep breath, duck into it, and as it settles firmly on my shoulders, I climb slowly down. The sensation just above water is of unbearable weight, but the instant I immerse

this goes and the weight of the helmet with all the lead is only a gentle pressure, sufficient to give perfect stability. Meanwhile Ruth Rose has started the pump.

From a blurred view of the water surface and the boat's stern, I sink instantly to clear vision under water. I descend three rungs and reach up for the short harpoon or grains which is put into my hand. At the fourth or fifth rung the air presses perceptibly on my ears and I relieve it by swallowing. For the first moment there is a muffled rumble of bubbles escaping, which I never noticed until I heard Ruth exclaim about it. This ceases as soon as the helmet is entirely under water. I descend slowly, swallowing now and then, and when the last rung has been reached, I lower myself easily by one arm, and lightly rest on the bottom. If serious danger threatens or the pumping should go wrong for any reason, I have only to lift up the helmet, duck out from under it and swim to the surface. The level of the water keeps constantly at the level of my neck or throat, and if I lean far forward it gradually rises to my mouth. But there is no splashing, no sense of oppression.

In most of the great changes or experiences which come to us humans, such as seeing our first palm tree or circus or volcano, the first reading of Alice, diving, a battle, discovering the method of complete relaxation or really being *in* the only Borneo in the world, it is not, as so many people think, the first few minutes which are the most wonderful. It is the subsequent gradual apprecia-

tion which develops that realization of the wonder and the beauty of the thing close at hand. It is so easy to miss this almost conscious appraisalment, and after the trip or performance or experience is past, we long for just one moment of the actuality, so that this or that could be seen again and remembered more clearly. Before I started on my trip around the world in my search for wild pheasants, someone gave me one of the most valuable hints I have ever had. It seems a foolish little game when I come to write it down, but it is based on a very sound realization of a great human weakness—the contempt bred by myopic familiarity, the absolute necessity for even an artificial perspective. It consists merely in shutting your eyes when you are in the midst of a great moment, or close to some marvel of time or space, and convincing yourself that you are at home again with the experience over and past; and what would you wish most to have examined or done if you could turn time and space back again. A hundred questions rush into this induced mental vacuum—what were the color and shape of the wild blossoms upon which that pheasant fed? What was the sound of the anti-aircraft shells? At what speed did the lava flow? etc.

And so, as I said, I swung myself lightly down from the ladder and stood on the bottom. I gazed out with interest on the rocks and fish about me, but felt a vague feeling of disappointment. I was breathing so easily; the water outside might have been correctly heated air as far as any bodily sensa-

tion went; I was looking through a pane of glass at fish swimming about—exactly what I have done and seen a hundred times in our aquarium in New York. I felt only as if I were in a very small, strange, but perfectly comfortable room, looking upon a wonderful tank of living fish with a most excellently painted background. The shock of entrance into this long-anticipated world had not been as radical as my imagination had pictured, even although I cannot recall having visualized instant attacks by huge sharks, or the feel of the snaky tentacle of an approaching great octopus. The fact of my bodily comfort and the vivid memory of aquariums all over the world had deadened the stupendous marvel of it all.

I sat down on a convenient rock, shut my eyes, and recited my lesson: *I am not at home, nor near any city or people; I am far out in the Pacific on a desert island, sitting on the bottom of the ocean; I am deep down under the water in a place where no human being has ever been before; it is one of the greatest moments of my whole life; thousands of people would pay large sums, would forego much for five minutes of this!*

This was enough. I opened my eyes and saw, resting on a rock not more than three inches away from my face, the red bull of Kim. It was the strangest little blenny in the world, five inches long and mostly all head, with tail enough only to steady him in his place on the boulder. His long snout with nostrils flaring at the tip, his broad, flat crown surmounted by two curving horns,

made him absurdly like a prize bull. He was dull scarlet with splashes of golden brown along his sides, which was well enough, but a bull does not have tatters and fringes of blue and yellow scattered all over him (unless we choose to consider the cruel banderillos as ornamental). My blenny's eyes were silver with hieroglyphics of purple in them, and as I looked, he puffed a puff of water at my window and was gone.

I was quite reoriented now. The hardest thing was to realize that I was *wet*. It was the old story of the value of comparison. All of me was wet and I could not reach up into dry air, so I had no sensation of wetness. I looked at my fingers, however, and saw the beginning of washerwoman's wrinkles, so was convinced! I reached out and picked a starfish from the rock in front, and as it slowly crawled over my hand, I realized to the full that this was a wild starfish and not one brought from somewhere else and placed there for me to look at.

One handicap, present at every submersion, was the impossibility of writing down notes, except on an awkward slate, the multitude of exciting experiences and hosts of remarkable creatures so distracting my attention that my memory was strained to the utmost to recall a clear sequence of events. This I hope to remedy in a made-to-order helmet which shall contain a cheek pouch of sorts, to hold a little writing-paper roll and a pencil, in the dry air of the side of the helmet, at the left of my face.

It was the morning of April ninth when I went



FIG 18.—DIVING IN TWENTY FEET OF WATER IN DARWIN BAY SURROUNDED BY HUNDREDS OF FISH OF SEVERAL DOZEN SPECIES

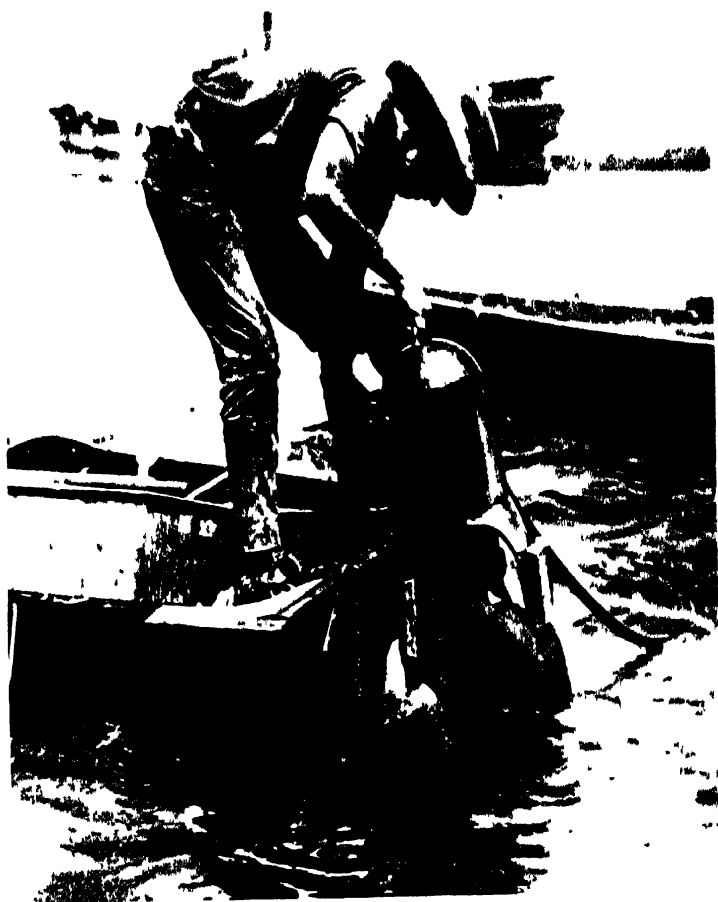


FIG. 19. MAKING READY TO DIVE

Placing sixty pounds of copper helmet and lead weights over the head of the diver

down for the first time, on a coral bank in Darwin Bay. I made five descents but recall very few details, because at the moment when I was ducking inside the helmet for the second time, I saw, a few yards away, one of the largest grey sharks I have ever seen, a giant of a generous eleven or twelve feet, cutting the water with his great dark fin. My companions did not fail to remind me of my notorious scorn of sharks, so with a rather sickly grin I went down. The dominant impression of this first experience was of the disconcertingly narrow field of vision—the oblique panes of glass in the helmet permitting only about sixty degrees. What I had seen at the surface kept my imagination busy with the keenest desire to see what was transpiring in the remaining three hundred degrees of my visual circle. I am certain that from above I must have looked like some strange sort of owl, whose head continually revolved first in one and then in the opposite direction.

It is idle to say that I, and I think all of us who went down, did not feel at first exceedingly nervous. It was disconcerting, as I have said, not to be able to see directly behind by a quick turn of the head, and until I became accustomed to the nibbling touch of some little fish who was investigating this strange creature so new to its world, I would often leap up in expectation of seeing some monster of the deep about to attack me. This stage passed and I soon felt perfectly at home. On the very few occasions when some creature seemed tempted to make a tentative hostile approach, it

appeared to be the snaky hose extending to the surface and the constant stream of bubbles which deterred it.

In the afternoon of the same April day I submerged near the foot of the great cliffs, and, as I have described, disciplined myself into a greater realization of the wonder of it. I think my first surprise was of the constant movement of everything, not so much individually as of the whole in relation to the rocks and bottom. I knew of course that the boat was rising and falling with every surge, which heaved and settled in turn as each wave passed, to break against the cliffs. I found this same motion extended downward, with less and less force, until at thirty feet it all but died away. At present in about twenty feet of water I felt it strongly. I would be sitting quietly without the slightest tremor, when, gently and without shock, every fish in sight, every bit of weed or hydroid, the anchor rope, the shadow of the boat, the hose and myself swayed toward the land. One could resist it by clinging firmly to the rock, but the supreme joy, because of its impossibility in the air above, was to balance carefully and let oneself be wafted through space and deposited safely on the next rock. There followed a period of complete rest, and back again everything would come. It was so soothing, so rhythmical, that one yielded to it at times in a daze of sheer enjoyment. Where the water is not too deep and the bottom is sand or powdered shells, it is evident that the great surges are not a simple, compact movement, for here are

made visible little, individual whirlwinds and casual, separate breezes which twist the shell-dust about or send up clouds of sand about my body.

In days to come I was to find the surge sometimes a very real danger, as when at Cocos I went down in a smashing thrashing sea and was scraped and torn back and forth across lacerating knife-points of coral and poisonous spines of urchins until flesh and blood could no longer stand it. Like getting one's sea-legs it soon became second nature to anticipate the swell, to lean against it, to shift the balance, so that everything moved except myself and the eternal rocks.

Now, day by day, occurred the accidents by which I learned how to do things, little by little relinquishing the ideas which, on dry land, had seemed feasible and important. For a day or two I could not understand why, during certain dives, the fish were so much tamer than at other times. The clue came to me when a rather heavy swell was running and I found that if I gave to the movement of the water, all the inhabitants, from gobies to groupers, from shrimps to sharks, accepted me as something new but harmless which the waves had washed in, but if I resisted the aquatic wind and maintained place and posture, I became an object of suspicion. This was the first of many radical differences which I was to find between the world of dry land and that of the under-water; on land, to move is to arouse fear among the wild creatures, here I did it by remaining still.

I walked or half-walked, half-floated, toward the cliffs. The rocks were almost bare in this bay, like those between tides, and the multitudes of lesser aquatic creatures were concealed beneath them. The water was quiet, and between surges was often perfectly clear, so that I could see plainly the cliffs rising high in air above that narrow straight line which marked the division between the two kingdoms. I went as far as my hose tether would permit and reached a boulder on which, the day before, at low tide, I had sat comfortably in the clear, cool air of the upper world.

Turning back, I saw that I had become a Pied Piper of sorts, leading a host of fish which followed in my train. The sun was out now in full strength and no fish, however strange and unknown to me, could hold my eyes from the marvel of distance. As I walked toward the cliffs I had also worked a little toward the east and the view I had, as I turned, was of another slope than that over which I had come. The bottom thus far was not wholly unlike the cliff above the water, but before me now the slope fell away in a manner which was beyond all experience—a breath-stopping fall, down which one could not topple headlong, but only roll and slide slowly, to be overcome, not by swift speed of descent or smashing blow, but by a far more terrible slow increase of pressure of the invisible medium, whose very surface film is death to us. To detect a faint, colorless shape now and then, through the azure curtain, and never to know whether it was rock or

living creature—things such as this made every descent an ineradicable memory.

My range of vision was perhaps fifty feet in every direction, but for all I could tell it might have been fifty feet or fifty miles. The sun's rays filtered down as though through the most marvelous cathedral ever imagined—intangible, oblique rays which the eye could perceive but no lip describe. With distance, these became more and more luminous, more wondrously brilliant, until rocks died away in a veritable purple glory. No sunset, no mist on distant mountains that I have seen, could compare with this. One had to sit quietly and absorb these beauties before one could remember to be an ichthyologist.

As I was revelling in pure sensuous delight at this color of colors, a small object appeared in mid-water close to my little glass window, and was instantly obscured by half a dozen little fish which darted about it, some actually flicking my helmet with their tails. Just as I saw that the suspended object was a baited hook, a baby scarlet snapper snatched at it, darted downward, and was at once drawn up into the boat. As I looked after it an idea came to me and I followed the snapper upward by way of the ladder. When the helmet was lifted off and I could speak, I expressed my wants, and descended again. Soon there fell slowly at my feet a small stone to which was tied a juicy and scarcely dead crab. I picked this up, waved it back and forth so as to scatter the impelling incense of its body and as if by magic, from behind

me, from crevices upon which I was seated, seemingly materializing from the clear water, came fish and fish and fish. It is far from my intention to give a detailed list of all of these. The effect upon the reader in this connection, would be much the same as my own sensations at this time, if, by chance, my friend working the pump in the boat above had suddenly dropped off to sleep. Their names, numbers, colors and habits are all set down elsewhere in a more suitable place—*Zoologica*.

Even if I wished to speak of them in a homely way I could not, for most of them have had visited upon them the names only of the official, scientific census-taker, while the rest have no names at all. So Adam-like, I had to give them all temporary names, until I could identify them, or christen them with my own binomial terms. It was long before I could disentangle individual characteristics from the whirling mass (Fig. 18). The first four fishes rushed for the bait—

“And yet another four;

And thick and fast they came at last,

And more, and more, and more—”

so that until I could shut my mind to the abstract marvel of it and my eyes to the kaleidoscopic, hypnotic effect, ichthyology gained little of specific factual contribution. I waved my magic crab, I may have murmured Plop! Glub! and Bloob! which is what the bubbles say when I first immerse—and the hosts came. Within three minutes from the time when the crab first fell into my hand, I had

five hundred fish swirling around my crab and hand and head. Similes failed. I thought of the hosts of yellow butterflies I have seen fluttering at arm's length on Boom-boom Point; I thought of the maze of wings of the pigeons of St. Mark's, but no memory of the upper world was in place here,—this was a wholly new thing.

Often there was a central nucleus a foot or more in diameter, of solid fish, so that the bait and my arm to the elbow were quite invisible. Twenty or twenty-five species were represented, and, like birds, they were graded with exquisite exactness as to correlation of fear and size. The great majority were small, from two to four inches in length, and these were wholly without fear, nibbling my hand—passing between my fingers but always just avoiding capture, no matter how quickly I shut my fist. Six- and eight-inch fish also came near, but were more ready to dart off at any sudden movement of mine. On the outskirts hung a fringe of still larger fish, hungry, and rushing in now and then for a snap at the delicious morsel which they saw their lesser fellows enjoying, but always with less abandon to the temptation of the moment. The tameness of the little chaps, however, was so astounding, that the relatively greater wariness of the larger fish scarcely deserved the name of suspicion, not to say fear. Another unexpected thing was the rapidity with which these fish lost even this slight suspicion and learned to connect my appearance with food. If I dived in the same spot several times a day and several days in succession, fish

would approach in numbers and investigate my hands and trident with much greater eagerness and, I presume, with expectancy, than they ever displayed on the occasion of the first dive, before I had repeatedly tempted them with freshly killed crabs. I could even recognize certain individuals, characterized by some peculiarity of color or form.

Before I go on to speak, even casually, of the fish themselves, I must tell of my second discovery. As with the crab baiting, and so much else in my life, it was by sheer accident that I learned of the possibility of spearing fish twenty to thirty feet under water. The first few times I dived I carried a powerful harpoon with a long metal handle, thinking I could lay it down and pick it up more readily than if it had been buoyant. The big, green grouper which I mentioned in my opening sentence was bothering me, shoving his big jaws close to my arms and legs, so I struck idly at him, missing of course, and to my astonishment, he instantly attacked the prongs of the trident. Again I stabbed when he was broadside on and struck him so hard that he tore away with difficulty, whereupon he took himself off, and sulked under a great mushroom coral.

I remembered this incident and the following day had a special grains made out of three large, straightened fishhooks, fixed in the end of a yard-long wooden handle. This I took down with me and waited until my regular crab bait came sailing down. I caught the stone and wedged it in a

crevice of the rock, where the crab was only partly exposed. The fact of the invisibility of the food made little difference in the swiftness and the numbers of the arrivals. Their keen powers of scent drew them like filings to a magnet, and although only three or four fish could find room for a simultaneous nibble, yet scores waited behind, or pushed and wedged themselves in, reminding me of the buffet at a supper dance.

At last I decided to try my new weapon. On several former descents I had noticed a very common fish which was new to me, and now there were twenty or thirty in sight, nibbling at the crab, swimming in and out of crevices, and doing all the things which are imperative for small fish to do on occasions such as this. They were smug little fellows, high-backed like sunfish, brownish-black, with only two outstanding features,—delicately beautiful bright orange tips to the pectoral fins and a white base to the tail. Twice I leveled my trident and stabbed, and twice I missed. Then I found a new point of balance along the handle, struck again, and had a fish caught fast—my first *Pomacentrus leucorus* (Fig. 21).

And now my under-sea sprang a new surprise on me. Although I am a scientist and a hunting scientist, I hate to take life. Under the provocation of extreme danger to me or mine, I have always valued human life at less than nothing, but shooting down a savage as he is rushing you is one thing and deliberately spearing a fish which you have been watching and which swims about close to

your face and hands in perfect fearlessness is quite another. However, one can be tender-hearted without being sentimental and if I need the facts for science, to complete the life-history of a whole species, I will shoot a dove on her eggs without compunction. I sympathize, on the other hand, with the Hindoo fishermen of the Laccadives who are not allowed by their faith to take life, and hence, when they have drawn their nets, they rush ashore and lay the still living fish gently upon leaves and moss. Later they return, and finding, to their surprise, a lot of fish which are quite dead, it is permitted that they gather them up to sell or to eat.

So it was not with the unmixed feelings of a triumphant Neptune or a successful ichthyologist that I clambered up the ladder, and when near the surface held out my trident with the impaled fish. My pleasure in the feat was heightened when I finally ascended and found my fish swimming unconcernedly about in the well of the boat. As a matter of fact, a much greater percentage of my speared individuals recovered and survived, living and feeding contentedly for weeks in our aquaria, than of those we caught on hook and line. Almost invariably the tip of the grains would penetrate only the mass of back muscles, leaving quite untouched the head and the vital organs of the body.

I experimented with all sorts of methods, such as putting a bit of crab on the trident itself. This was a complete failure, for the fish would crowd around it head-on, and with all my efforts I never

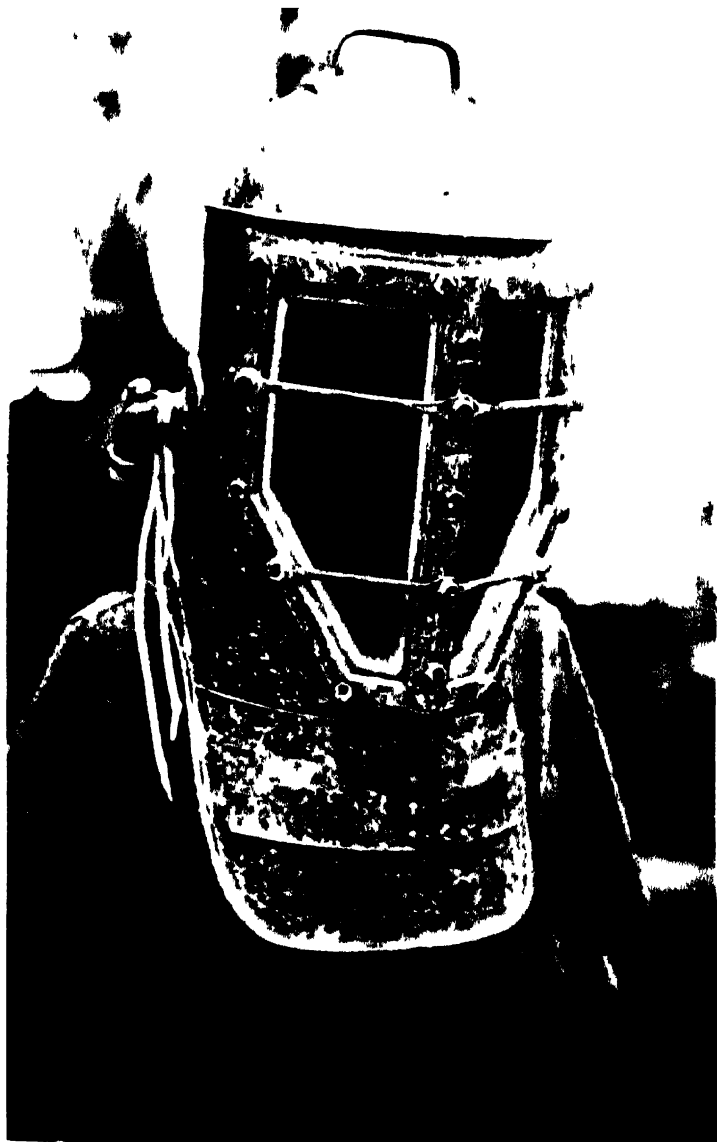


FIG. 20 WILLIAMS BELL IN THE DIVING HELMET

It merely rests on the shoulders, kept there by its own weight



FIG. 21 — THE AUTHOR IN TWENTY FEET OF WATER ON LARGE CORAL BOULDERS ABOUT TO HARBOON A RARE FISH



FIG. 22 — MOORISH IDOL, A BRILLIANT SHORE FISH OF THE GALÁPAGOS

succeeded in even touching a fish when in this position. It can very naturally shoot forward and backward with infinitely greater speed and facility, than move sideways against such a heavy medium. So my efforts were always directed at fish broadside on. This method of attack was so new to their experience, that even when just missed, they darted aside only far enough to escape the thrust, then returned at once and examined the trident with deep interest. Sometimes I would scrape off a few scales and then these most astounding creatures would rush back in great excitement, and snap up, one by one, each floating scale, "getting a bit of their own back," as it were.

The smaller fish were as easy to reach with the prongs as if they were blackberries fastened to a stem, but they were so small and agile that they slipped between and around the barbs. The easiest of all to secure were the medium-sized herbivorous fish such as the yellow-tailed surgeons and the gorgeously colored angelfish. These came inspired only by curiosity and drifted about me aimlessly or nibbled at the rock by my elbow. The sign of Cancer meant nothing to them, and their efficient poisonous spines or defence of whatever kind wrought a self-confidence which carried them through life calmly and without fear. I had merely to wait until they approached and turned their broad profiles when a quick flick of the wrist meant their transference to life in one of our aquariums—where they continued to live placidly and undisturbed by any change which fate had brought to

them. The number of the surgeons which I took was limited only by my desire for specimens or the capacity of our aquariums, for my capture of one conveyed no alarm or sense of insecurity, and when I again climbed down the ladder the chances were that I would find the remainder of the school in the same spot, undisturbed.

The best sport was to be had with the brilliantly colored wrasse. They were among the most active and swift, slender and supple as eels, with an abundance of fins for doing everything that perfect control demands. Two species in particular were always about, although never more than a half dozen were in sight at once. Nature must have relegated the coloring of some of these fish to an amateur assistant, for it was crude, blatant and, judged by human ideas of ornamentation, in execrably bad taste. Yet as I saw it—a living organism—winding in and out of dark crevices, or twisting almost on its back to get a nibble at crab meat, it seemed rather an exquisite mass of palette splashes. The head was scarlet, the body, fins and tail mostly bright grass green. The head was outlined in dark blue, and from the lips, which were solidly of the same color, five blue lines streamed backward, flowing in irregular bands through the eye and across the cheeks, saturating the pectoral fins. The whole green body was thickly banded with irregular vertical lines of an unnamable dull maroon—like thick heavy streaks of some awful rain or acid stains. The tail had a stiff, unnatural pattern, like a great scarlet H drawn crudely over

the green. I was happy when at last I outwitted a six-inch green wrasse, and put him aboard, where he lived for two months, allowing us to paint and study him at our leisure.

The other wrasse was simpler; but even more striking in pattern and coloration, and to the last defied my every effort. Twice I struck and marked them, and day after day the same individuals would come about as bold as ever, flaunting their scars and wounds in my face. One of these had two jagged holes well into his side, yet they apparently gave him no concern, nor interfered at all with his speed and control, and he easily avoided every attack which I launched. These fish were about five inches in length, bright tyrian purple over all, with a broad vertical band of sulphur yellow extending down from the neck around the body and including the pectoral fins. While I was exerting every muscle to get him, I called him many names in the quiet of my helmet, but these are neither here nor there. No written description fits him, and until I return and with greater skill succeed in overcoming his cleverness, he can be called only the Yellow-banded Purple Wrasse.

Armed with my crab meat I often sat and watched with my face close to the center of interest. The mass of fish was composed of a bewildering array of forms, yet both here and in the other islands where I dived, there were several dominant species. On almost my first dive I welcomed with a shout—a shout which echoed only within my cubic foot of air—my old friend of two

years ago, the blue-lined golden snapper, *Evoplites viridis*, which I then pictured in color.¹ These beautiful fish were abundant, and although many quickly gathered when crab meat was provided, yet as a rule, they were solitary, swimming about singly close to the bottom. One day in one spot we caught thirty-eight with hook and line as fast as we could pull them in, but none of these lived, while one which I harpooned thrived for many weeks. Most were six- to eight-inch fish, but occasionally I caught fleeting glimpses, in deep water ways, of giants nearly three feet long. They were voracious and when they dashed in for a snap at the crab, they often seized the entire joint of a leg which they swallowed whole.

The little round, brownish-black *Pomacentrus* fish of two species were the most abundant of the four-inchers, and, as I shall relate more particularly in another chapter, were the most absolute home bodies, each living in his particular crack or crevice, from which he frequently rushed out and attacked ferociously any fish which approached too near, regardless of its size.

Another field of work of tremendous interest was suggested when I turned over the first stone and saw the mass of life covering the underside and filling the crevices. I arranged to have a pail lowered on a rope, and squatting low on the floor of the bay I filled the pail and gave the signal to draw it up. Five pailfuls provided a tub of rocks. This was left standing in the sun for a day and at

¹ Galápagos: World's End, Plate V.

the end of that time there had crept out an amazing array of interesting beings,—beautiful sea-worms, starfishes, squillas, hermit crabs, and shrimps of every hue, a number of strange larval fish and an adult formed, wonderfully patterned, quite fearless moray eel exactly one and one half inches in length. This tapped a fertile and untouched field, providing organisms which cannot be dredged because of their shelter under and within coral and stones, and not to be gathered by wading along shore at low tide, since twenty feet of water lay above them.

The obliquity of the two windows in the helmet made it necessary to look out of either one or the other exclusively, when engaged in observation or work which required accurate correlation of eye and hand. Seldom have I seen a funnier sight than the earnest efforts of any of our party before they learned of this optical effect. Through the water-glass a pale figure would be seen crouched on the bottom, industriously picking up stones and carefully dropping them about two feet from the bucket. After much hard labor, the helmeted creature would raise the empty bucket and gaze at it in puzzled astonishment. In imagination we could see the large question mark poised in mid-water over his head. Another labor-saving individual decided to pick the specimens themselves off the rocks, and long streamers of algae and clumps of hydroids were gathered and carefully placed in the bucket, only to float instantly out and up to us, while he was looking for other equally buoyant

specimens. Don Quixote's horse was nothing compared to the worker's ultimate idea of the capacity of that pail (Fig. 20).

From first to last I could never guess, from examining the bottom through a water-glass, what a submersion would yield, or even look like, except in the most general, superficial way. It was like judging a shore line from a ship with all the indentations flattened, all the coves and little bays concealed in the optical straightening, and the wicked, crashing breakers smoothed from behind into harmless appearing ripples. In many lights, the bottom, even only twenty feet down, appears merely undulating or paved with huge stones.

One of the last dives I made in Darwin Bay showed such an aspect from above. I went down rather deeply, but very slowly, for I always came under the spell of the ever wonderful blueness of distance. It seemed impossible, even after all the times I had studied it, that invisibility or opacity of whatever distance could result from such a luminous medium. When at last I rested on the bottom I watched three white-striped angelfish chasing one another in sheer play. They drew my attention upward to where they were breaking the surface film, not far from the boat whose keel was hobbling absurdly up and down. The angelfish then curved downward, the long filaments streaming from the fins above and below, and giving the appearance of even greater speed. They rose and fell, circled about, turned on their backs and fell into nose dives as easily as I sat still. Finally, the

emotion over, whatever it was, they all came to rest still high up in mid-water. It occurred to me that in comparison, our own world is practically one of two planes, while this is really the one of three. It is fair to compare fish only with birds, and even birds need two perching props, and do not dare to develop wings or feather fins beneath the body, for, sooner or later, they must alight, while a fish can live, eat and sleep poised in mid-water.

I turned my attention from the fish to the scene behind me and the absurdity of my appraisal from the water-glass became apparent. I was standing a few yards away from a boulder as big as a cottage, and my heart gave a leap as I saw a curved flight of steps—giant steps like those up which I had once climbed Cheops. They began on my side at the doorless entrance of the sinister cottage, slowly encircled it and vanished behind it in a soul-stirring abyss of blueness, which, from a delicate shade near at hand, blued more and more clearly into infinite depth and space. I believe that Sime would have loved this scene, and Dunsany would have deemed it not unfitting for the habitation of Gnoles. Töten Insel treasured no more mystery in its perspective than did this. As I watched, a bit of greenish black coral which projected eave-like, began to move and crawl slowly downward, and with it went dangling things which I had taken for strands of dead seaweed, but which on this edifice might well have been awful stalactites or icicles of sorts. The octopus climbed down,

hesitated, felt about in different directions, and then descended the steps, flowing along the angles like some horrid viscid fluid in animal form. The most active imagination could not have set the scene better, or found a more appropriate actor.

But like the double miracle of the stars falling into the volcano the end was not yet. A mist of yellow-tailed surgeons drifted across the stairs and the dread boulder, and for a moment their calm matter-of-factness lessened the sinister feeling of the whole thing. A strong desire arose to look around the corner of the stair for myself. I was submerged so deeply that as I stood, I could barely reach the lowest rung of the ladder, indeed I was occasionally lifted a few inches from the ground as the boat rose to a greater swell. But I knew the hose was new and stout and even if I began to fall with that terrible slowness, as seemed easily possible to my imagination, I could surely climb back up my own string. One finger relaxed and I was about to take the chance when a mote, very faint and pale, stirred the blueness as if some wondrous tapestry curtain were troubled by a breath of air.

The thing grew denser, took form and became concrete, and a flat, round-fronted head, lazily undulating, wound through the water over the steps, a nine-foot shark weaving along where I would have been a minute later. My common-sense theory of the harmlessness of these beings still held good; in the last few days dozens of them had approached within a few yards of me, but the

eerie character of this place had penetrated even my prison of copper and glass, and when I realized where my precious ladder would drift to when I relinquished my hold, looked down at my unprotected limbs and realized that I had not even a trident with me, I decided to go through life with the mystery of the stairway unsolved. The great, grey being, wafting along its hundreds of pounds of body by slow, gentle undulations, kept on and on until again hidden by the blue light. When I ascended to a world of greater reality, I took with me the memory of the beings to which legend and fact have brought the greatest notoriety of anything in the sea, and the setting in which I found them will never pass from mind—the Edge of the Edge of the World.

CHAPTER IV

ALBATROSSES

THE first time I ever saw an albatross was at dawn far out in the Indian Ocean. It was that hour at sea when perspective does not exist, and, like the houses of a tropical coastal city, everything appears flat and on one plane. I was observing a small flock of petrels from the rail of my vessel when a lighter colored bird appeared above them, apparently of the same size. As I watched, it grew larger and larger, until, to my amazement, it joined the petrels, and in the same instant they were dwarfed to insect size while this white bird assumed relatively gigantic proportions, and I knew that I was seeing the effortless flight of an albatross.

For years thereafter my eyes were always on the lookout for these birds. In southern seas and in the north Pacific one may hope to find them, but not on our own boreal Atlantic. A great many years ago, however, long before man began to have sufficient perspective of his ancestry to worry about it, albatrosses were calmly winging their way over our northern seas, and we find their fossil bones both in England and America. A vast amount has been written about their flight but to-

day we watch them with quite as much ignorance of how they contrive it as when the first mariner saw and marvelled. So close to the water they skim, so automatically they rise and fall, outlining the unpredictable movements of waves, that they seem to possess all the secrets of white shadows. When we watch closely and less emotionally we begin to see the part which wind plays in the support of this relatively heavy mass of flesh and feathers, throughout the tens of thousands of its miles of progress. The albatross is never so supreme and relaxed and effortless as when it is coasting up-wind, but a breeze on the quarter is less sustaining, and when flying with the wind, frequent circles and intersecting spirals are necessary to attain and sustain sufficient impetus and altitude. This is the fame of the bird, and throughout history and literature almost every mention of it has been synonymous with supremacy in flight.

Once seen and recognized, an albatross can never again be mistaken for any other bird; its great size, the unusual length and ribbon-like narrowness of its wings, the large, yellow, hooked beak—all these mark it even at a distance. The ease and lack of effort of its flight are deceiving, and only when it circles and encircles a fast-moving steamer do we realize the terrific speed of which it is capable.

Albatrosses are usually classified as a family in the order of birds known as Procellariiformes, or oceanic swimming birds with the nostrils arranged in two long tubes lying along the beak. Their

nearest relatives are the hosts of little black and white petrels or Mother Cary's chickens which abound on every ocean and are familiar in storm and calm. In fact it would not be far from the truth were we to call petrels dwarf albatrosses, or the latter giant petrels. Diversity in size is probably as great in this group of birds as in any corresponding assemblage of animals on the earth. Within sight of one another I have collected an albatross and a petrel, the former weighing one hundred and fifty times as much as the latter, while the albatross had a spread of wing seven times as great as that of its tiny relative. There has been much written of truth and of exaggeration in regard to the wing spread of albatrosses. I am inclined to agree with the words of Dr. Lucas, who writes of the wandering albatross "it is also the largest species, having a stretch of wings of about twelve feet—an assigned dimension of seventeen and a half feet being either a great exaggeration or highly exceptional." In the Eocene, however, there lived an albatross-like bird, which, judged by the size of its fossil bones, must have had a spread of wing of at least twenty-two feet.

In birds so evidently related as petrels and albatrosses but differing so greatly in actual size we have most interesting evidence of possibilities of flight character. It would seem impossible for any small bird to soar for any length of time or to go for any distance without actually flapping. I can recall no bird of small size which has this ability, while such past-masters of non-flapping flight as

vultures, pelicans, screamers and albatrosses are all large and heavy of body. I have made over three hundred flights in airplanes myself, in peace and war, close to the ground and once up to an altitude of twenty-two thousand feet, yet the way of an eagle in the air is still, to me, inimitable, and always will be unless we can duplicate its great air chambers, the lightness and strength of its hollow bones, and the friction-evading plumage.

The part which albatrosses have played in relation to man is interesting. First, admiration for its flight by early mariners, and a sense of companionship and camaraderie in its society in the desolateness of mid-ocean.

“And a good south wind sprung up behind;
The Albatross did follow,
And every day, for food or play,
Came to the mariners’ hollo!”

This feeling, in the course of years, very naturally developed into an affection, and this, vitalized by the superstitious sub-stratum of the seaman’s mind, increased to a resentment of any attempted injury.

“God save thee, ancient Mariner,
From the fiends that plague thee thus!—
Why look’st thou so?” “With my crossbow
I shot the Albatross.”

And I had done a hellish thing,
And it would work ’em woe:

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For all averred I had killed the bird
That made the breeze to blow.
"Ah wretch!" said they, "the bird to slay,
That made the breeze to blow!"

The extreme of ridiculous theory is to be found in a very old book by Wiquefort, who says "these birds are often seen fleeping in the air, entirely remote from land, with their head under one wing, and the other employed in beating the air!"

There came a day when the homes of these birds were discovered, usually a tiny coral focus of the scattered individuals which roam so far and wide over the oceans. One island became known to some Japanese who had neither pity nor superstitions, and before President Roosevelt could enforce his sanctuary legislation they had starved or carved alive nearly a million albatrosses for their wing feathers which were sold to milliners as eagle plumes. Then sentiment and kindness again became dominant—the feather markets in our cities were closed and wardens appointed on the tiny islets, and if the desire which museums have for endless series of skins can be controlled, it may be that for many years these magnificent birds will continue to share this good earth with us.

There is an authentic record of an invaluable, although it must be admitted involuntary, benefit rendered to man by an albatross. Some years ago there fell exhausted and dying from starvation upon the beach at Freemantle, West Australia, a great albatross. When found, it had a tin plate

fastened around its neck on which was scratched the news of the wrecking of the French ship *Tamaris* three weeks before, and the survival of thirteen of her crew on Crozet Island. During this period the albatross had flown over four thousand miles of ocean, too terrified by its burden to stop to feed. It was a remarkable incident, quite reversing the experience of the ancient mariner;

“Instead of the cross, the Albatross
About my neck was hung.”

Intellectually, man's relation with albatrosses has been less spectacular but of equal interest. Linnæus, one hundred and sixty-eight years ago, first played taxonomic Adam to the albatross, calling it *Diomedea exulans*. Its godfather was probably therefore the famous hero of the siege of Troy, but Grecian etymology provides a much more poetic and appropriate derivation, and it is pleasant to think of the albatross, whether winging over foam crests or at home on its little isle as being ever *Dio-medea* or God-counseled. In its specific appellation Linnæus was also happy for to the ordinary observer, the wandering albatross is truly *exulans*—homeless, banished apparently from all connection with solid land.

It must be confessed, however, that Linnæus made a *faux pas* when he was led to associate in the genus of the great-winged albatross, the little fin-winged penguin—birds as unlike in habits as they are in physical makeup—suffering comparison only in their astonishing divorce from land,

and their extreme adaptations for continued existence in the air and the water respectively. One can readily tell that Linnæus was a closet, or at least a terrestrial, rather than a sea-going scientist, for his contribution to the habits of the wandering albatross are, "*æthera altissime scandens; victitans e Triglis volitantibus a Coryphæna exagitatis.*" But this bird neither attains great altitudes in the air, nor does it, to my knowledge, capture living flyingfish.

In more recent years, as additional specimens have been secured, more and more species have been differentiated, until the family Diomedeidæ now contains several genera, about a dozen well-marked species and perhaps twice as many more or less clearly defined subspecies. These latter distinctions must always be checked up with the fact that there are several distinct changes of plumage from nestling to adult, while, like most birds of large size, albatrosses develop rather slowly, and in addition to this there appears to be an unusual amount of variation in birds of the same colony and age.

But I shall get away from the spirit of this volume if I do not return to the living birds themselves. Fortunate is that bird or animal on the earth today which has found an isolated niche for itself, where it may claim comparative sanctuary. And this does not necessarily mean isolation from a geographical point of view. It may be a gastronomic one, such as the scavenger vultures have achieved, or the tough leaf diet of the hoatzin,

feeding on substances which are disdained by their fellows. Or it may be an isolation from fear of death by daylight, such as is engendered in bats and goatsuckers; or from actual low development of mentality as in the sloth; or an optical sanctuary such as an insect which in color, form and movement strives ever to be thought a leaf. But no more dramatic isolation exists than that of the albatross, which, although furnished with legs and toes, yet for most of its days spurns all solid earth and lives its life between sky and sea.

When I first saw albatrosses at their breeding ground I experienced a slight feeling of embarrassment, as if I were peeking through the blinds, or looking behind the scenes. I feel much the same when, in the rotogravure section of the Sunday paper, I see a photograph of some famous prima donna making an apple pie in her kitchenette. The voice of a *chanteuse* and the flight of an albatross are among the more wonderful things in the world, so much so that at first we hesitate even to think of the authors in relation to the trivial things of life. Whatever may be the case with the home life of a great singer, that of these famous birds shows the inevitable law of compensation. I have already courted displeasure in revealing an unromantic side of the Sargasso Sea, so I might as well continue and describe the gait of the Galápagos albatross. Its progress on land makes that of Charlie Chaplin appear grace itself, but for sheer amazing interest, the courtship and dances of these birds vie with its flight.

It was late in April when I completed my vain search for the Humboldt Current south of the Galápagos. After making certain that there were no signs of it within a radius of at least one hundred miles south of the Archipelago, I decided to steam north, and sighting Hood Island, anchored in a beautiful bay on the northwest side. As the *Arcturus* slowly felt her way toward the shore a flock of large black birds, swimming in single file, appeared off the port side and puzzled me until my glasses showed them to be albatrosses. Next to the active volcano on Albemarle this was the most exciting thing that Galápagos had offered on this trip. A few days after we had begun work at Hood my scouts reported that they had located the rookery several miles to the eastward. So on the evening of the twenty-fifth of April I made my preparations to visit them next day. That evening will not be forgotten by any of us for it was then that all the giant flyingfish in the world came alongside.

As usual, after dark, I lowered a cluster of electric lights near the water, and several of us took our places on the steps of the gangway. Almost at once large flyingfish began coming, and we caught several hundred. Looking down on them through the water their bodies appeared a beautiful pale green, and the wings bright pink, but in reality they were steel blue and wine color. About one in every fifty had the wings densely covered with round black spots. Never have I seen such uninterrupted terror or constant fear. During all

the early part of the evening we could see nothing in pursuit, no hint of enemies, yet the flyingfish dashed frantically about within the blaze of light, quite heedless of where they were headed. We had to be on our guard, for they would strike with terrific force against our bodies and the side of the *Arcturus*. Often such a blow against the ship would knock them senseless. Several rose and passed between the fourth and fifth steps of the gangway, so high were they able to rise from the water. Now and then there materialized a real reason for their terror, as a sea-lion shot into view, seized a fish and vanished. Far down we could see the forms of sharks—ghostly pale in the dim light—but none came close, except once, when I saw a shark rise and engulf one of the disabled flyingfish. These flopped by twos and threes into the small boats and in the morning we picked up over a hundred. It was an astonishing and a memorable sight, few of the fish being under a foot in length, and in such endless numbers.

Early next morning we started in the *Pawnec* launch eastward along the coast between Hood and Gardner Islands. We passed close to wonderful sea caves and could hear the swells booming into spray far within. At the entrance blue-footed boobies and pelicans perched motionless like guardian gargoyles and every available niche and ledge was filled with nesting noddy terns.

Our course took us head-on into the great rollers and as I lay flat on the forward deck, the walls of water ahead looked like solid jade,—the early

morning light shining through the thin emerald tops of the swells and tingeing our boat with the same color. Dolphins now and then rushed at us and leaped so high into the air that I could see the rising sun beneath their curving bodies, drenching me with spray as they fell back.

Four miles beyond we drew close inshore, but had to pick our landing place with much care, and even in the partly sheltered beach which we found, the cameras and guns barely escaped a soaking, as we staggered ashore up to our arms in water. A walk of half a mile inland took us around an impossible bit of shore, through a growth so dense that we could see only a few feet in any direction. Everywhere we passed the dry beds of drainage streams, through which, after cloudbursts, torrents must make their way to a lake which at present was a half-dried marsh. This was filled with mosquitoes, apus and branchipus fairy shrimps. Much of this end of the island was almost level, with occasional tall pinnacles or spires of broken lava which rose high and slenderly above the scraggly trees and shrubs. The going was easy as there was only a small amount of thorny mesquite and cactus. Black finches and mockingbirds chirped and flew close to us, and rarely a great bee zoomed past.

Suddenly in front of me a white head and neck shot up from behind a bush, and a few steps brought me to my first nesting albatross. After this we found them scattered about, sometimes singly or again in pairs, with or without an egg.



FIG. 23.—HOOD ISLAND ROOKERY OF BOOBIES, GULLS AND ALBATROSSES.



FIG. 24.—GALÁPAGOS ALBATROSS ON ITS EGG.



FIG. 25.—THESE ALBATROSSES HAVE NO FLAIR OF MAN.

Twice I came across an unattended egg lying absolutely in the open on the level, red lava soil, without the slightest hint of nest. Not far away were six pairs of birds sitting close together.

Coming over a low rise of ground we suddenly saw the shore close at hand, and a most wonderful panorama to east and west. Two headlands curved around before us to the right, while straight ahead a third ended in a high arched natural bridge of lava. Everywhere, from our feet to the tip of the headlands, were nesting birds—thousands of pairs of olive-footed white boobies, with small colonies of frigatebirds here and there, and occasionally a pair of blue-foots. Galápagos gulls were sitting on their eggs beneath the arch of the bridge, and shearwaters swooped in and out of the foam. The boobies were well along in their nesting season, for the ground was covered with half-grown, snowy-white nestlings, which unceasingly snapped and squawked at us (Fig. 23).

Back of the headlands and all along the shore, somewhat removed from the main mass of nesting birds, were the scattered albatrosses, probably a thousand all told, two or three pairs close together, or a single bird quite isolated. Some were casually resting, and these rose to their feet at my approach and waddled slowly off. But most had already chosen their nesting site and refused to leave either the bare eggless space upon which they squatted, or the great oval shell which they kept so close beneath them. The difference between the albatrosses and the other breeding birds, in respect to

my presence, was very striking. The former watched my approach gravely and without fuss or sound chose their course of action. If on an egg they permitted no familiarity, but snapped with their powerful hooked beaks, and vigorously resented any advance. With a stick I gently pushed one of the great birds back until the egg was uncovered, then took it up, examined it, and replaced it, when the parent, with no show of resentment or worry, shifted slowly forward, opened wide her breast feathers and gently sank close down upon it again (Fig. 25).

I am describing this rookery of albatrosses calmly, as if it was to me merely an extension of the myriads of nests of the other seabirds. But in reality it was one of the great experiences of my life, set apart from the rest of the rookery as Buckingham Palace is from the houses of Grosvenor Square. Here at last was the bit of dry land where these splendid creatures of the air deigned to alight and to carry on the affairs of everyday life.

I saw one coming in from the open sea, steadily as a triplane, without quiver or shift or balance of wing. When over the level ground the wings were tipped backward—the under surface presented as a brake, the legs lowered, the head held up, and with all its might the albatross bore back and began paddling furiously with its great webbed feet, seeking foothold as it taxied over the rough ground. Slower and slower became its speed, and finally the wings half reefed and gave

up their power. But the feeling of land was too unaccustomed a thing—the bird sagged sidewise, tipped over a pebble, half fell across one of its fellows, and turned over, rolling undignifiedly several times before it quite stopped. Then it rose unsteadily, gathered itself together and looked around, clattering its beak and shaking its head, doubtless, saying to itself, that the land was not what it used to be.

I watched this bird and followed it for a considerable distance inland, but at its very first step I realized anew how far specialization for the air had gone. Flat feet, fallen arches, rheumatic joints, crippled limbs—all were suggested in its painful, appallingly awkward gait. At each step the entire body turned with the leg, and the whole head and neck swung around and down on the opposite side to aid in balance and in supreme endeavor for each succeeding step. I have never seen a more ungainly, effortful mode of progression, and when thrown on the motion picture screen it arouses as much amusement in an audience as the peripatetic progress of Charlie Chaplin. Some day an epic will be written on the law of compensation, the most dramatic thing in nature—the peacock with its aristocratic, incomparable display of exquisite colors, and its Billingsgate squawk of a voice; the nightingale, embodiment of glorious soul-stirring song, with feathers of dullest russet and grey. And here were albatrosses, master flyers, tottering miserably along as if each step brought acute agony.

I walked slowly after my particular bird, sitting down to rest when it sat down, and trying to keep from laughing aloud at its frantic efforts to surmount the least inequality in the ground. A hundred yards were traversed before it came in sight of another bird which seemed to be its mate, resting upon an eggless bit of volcanic gravel. Before the birds met, mine sank exhaustedly upon the ground, ostrich-fashion, and settled down for a rest. I squatted about ten feet away and realized for the first time the real beauty of these birds. The great hooked beak is golden yellow and the head and neck purest white; the entire body is freckled with wavy grey, and the mighty wings are dark brown. Over the eye the feathers beetle outward in a most curious vizor-like fashion, and the large, dark eyes give the bird a gentle, kindly expression. Measurements taken later on showed that these albatrosses averaged over three feet in total length, and eight to nine feet in extent of wing, while the weight was about ten pounds.

As my particular albatross seemed settled for a while, I called on another bird about twenty feet away and gently pushed her off her egg. 'This I took for science' sake, salving my conscience with the certain knowledge that it would soon be replaced with another. It was a beautiful thing, as indeed all eggs are, very broadly oval with blunt, rounded ends, and measuring about three by four and a half inches. It was white with a dense cap of deep reddish brown at the larger end. This color died out in a sparse speckling along the sides,

leaving two-thirds of the shell immaculate. I later found that the contents made a delicious omelet after being carefully extracted through the tiniest of holes. I clearly remember the thrill when I blew my first egg, that of an English sparrow thieved from a mass of hay behind the attic window of my home, and now as I held this great shell in my hand I thought of all the eggs I had seen between,—those of pheasants in Tibet, junglefowl in Java, hoatzins in Guiana and hawks on the summit of Cheops, and I was grateful that the first thrill had in no wise lessened (Fig. 24).

But my bird showed signs of continuing its promenade, so I hastily returned. A half hour later as I was covering my last bit of paper with frantically scrawled notes, it occurred to me that there are three phases in the life of an albatross, each of which arouses in us a widely different, but profound emotion; first, admiration for its superb powers of flight, second, amusement at its ridiculous gait, and third, sheer amazement at the elaborate detail, studied sequence and formality of its courtship and play.

I had read accounts of this at other rookeries of albatrosses, but no description prepares one for the actual performance. My bird walked up to its mate which, in its turn, rose and faced the new arrival. They stood with their breasts about a foot apart. My albatross suddenly shot its head and neck straight up, the bill pointing skyward, uttering at the same time a deep, grunting moan. Its partner followed suit, then, alternately, each

bird bowed deeply and quickly three times. Without an instant's delay they next crossed bills and with quick, vibrating movements of the head, they fenced—there is absolutely no other word for it—with closed mandibles. Without warning my bird ceased and again shot his head high up into the air. Its mate instantly turned her head and neck far sideways and held them motionless and concealed from my point of view, close to the left wing and side. Then another double bow and a second bout. Next, both birds rested, looking quietly around as though nothing unusual were in progress, when the mate gave the stretching cue in her turn, and there followed a long bout of the fencing, this time my bird with widely opened mandibles, the other's beak even entering its mouth once or twice. For five minutes this performance kept up, when a third bird approached, bowed and engaged my albatross. This was only half-hearted however, and the third individual soon waddled painfully away, and the first two resumed the astonishing ritual.

I walked over to the third bird and bowed deeply and to my delight it bowed in return. Seeing no rapier bill, however, it solemnly walked away, until I again faced it and bowed when it returned my salutation twice and took a step toward me. That, alas, was as near as we could come to an engagement, but I shall never forget my amenities with this feathered D'Artagnan of Hood Island.

This intricate performance has been described

before, and probably all albatrosses go through something of the kind. It is *au fond* unquestionably a courtship, but I really think that it provides some sort of pleasure other than this alone, for I have seen it indulged in by a pair of birds which already possessed an egg, and again I saw one individual go through part of it with at least three other albatrosses in turn.

The sequence is not always the same, but the upward stretch always begins it, and all the phases are enacted by each bird in turn. The grunts or groans or rasping notes are sometimes frequent or the whole thing may take place in silence. There is no emotional climax. It begins and ends in the calmness which the gentle eyes of these birds and their philosophical treatment of an intruder such as myself indicate as a deep-seated character. Fortunately it was a very easy matter to obtain a perfect series of motion pictures of the fencing, and thus to preserve what mere words so completely fail to delineate.

I found that the sole food of these albatrosses consisted of rather small squids, and this seems to be the case with all other species, although like gulls, they have learned that galley scraps cast overboard are delectable dainties, and will follow vessels for many hundreds of miles on the lookout for such manna. As a quite radical change from squid diet there was once found in the stomach of a wandering albatross an undigested Roman Catholic tract with a portrait of Cardinal Vaughan.

When we finally left the rookery we walked up

to two isolated, lonely birds, gathered them under our arms and took them back with us. At first, on the *Arcturus*, they suffered severely from seasickness, but when they recovered they ate freely and lived for months in the Zoological Park in New York, admired by a host of people whose only acquaintance with an albatross heretofore had been through the woes of the Ancient Mariner.

CHAPTER V

THE BIRTH OF A VOLCANO

If there had never been but one opal, one peacock, one sunset and one butterfly what glory of history and legend would accrue to each. Men would have sworn great oaths of promise upon them and made them into sagas, they would be the ultra similes, a religion might have been founded upon one. But opals are worn for unlovely reasons upon unlovely hands, the man-given name is often deemed more important than the god-given idea of a butterfly, and a sunset, if not less than an interruption of dinner, is slighted because of the certainty of another on the following evening.

When a very wonderful thing comes into our lives for the first and perhaps last time, we betray our very birthright if we do not meet it with all the feeling and emotion and intellectual appreciation which is our human prerogative.

The *Arcturus* was anchored close under the steep cliffs of Darwin Bay—much too close for the Captain's ease of mind. In late afternoon I leaned on the rail and watched the gigantic blocks of basalt catch and reflect the salmon and coppery

bronze of the sunset behind me. Now and then it seemed almost as if they answered with a faint tinge of their own. I had spent much of the day in a diving helmet, clambering far down about the lower reaches of these same cliffs,—in a world where the word dry is without meaning and where the shadows of sharks instead of frigatebirds follow as they pass over my head. Now, for a while, the birds, even the garrulous gulls, were silent, and the quiet of my ears lent more power to my eyes which scanned the aged cliffs. So silent, so dead, so hard, so immutable were they, that no continent seemed more permanent than this tiny islet in mid-sea. Surely, when the world first cleared its face, these eternal iron cinders were here—cold, motionless, black as night.

There was still a tinge of rich color in the west when I went below, to eat and work, and talk of things so unimportant to stars. It was long past midnight when the booming voice of the Second Mate broke into my dreamless sleep, and brought me on the instant to my feet, clear-thinking and listening,—the heritage of a myriad nights in jungles and deserts. He beckoned me to the bridge and pointed toward the entrance of the bay. Something was there which should not have been. If at this hour, on the equator, a sunset afterglow still lingered, then indeed had the stars turned backward in their courses. A sudden idea came to me: “A ship on fire?” The mate shook his head, it was too big a glow for that, although only a splash of rose low down.

The next thought brought a gasp and a leap of my pulse,—a volcano! “I think so,” said my stolid friend, to whose sailor mind land and sea were phenomena only to be approached, passed over and left behind. I turned and saw the dim loom of the cliffs above me—so cold in the starlight, and the thought of their beginnings took on a sense of reality; there might be beginnings today.

Time after time I awoke and looked at the pink blur, and once a great shooting star fell slantingly into the very heart of the warm glow. It paled and vanished in the dawn.

My first selfish thought was to stop scientific work, drop everything and steam swiftly toward the strange sight,—the exact effect of a fire alarm on a school-boy. Then I found good and reasonable excuses. The thing itself was well worth verification, and the unexpected trip would interfere not at all with my oceanographic work. We did not wait even to hoist our flock of boats aboard, but towed them ashore, dragged them to the top of the beach and left them in the shade of the tent flies.

The captain said that the direction of the light was 256° of the compass circle, a bit of news which was utterly unintelligible until correlated with the more old-fashioned, visuable west-by-south-by-one-half-south. Eagerly I laid down a ruler on the Galápagos chart westward from Tower, and eighty miles away it came to rest on Albemarle. It touched the island far north of the five thousand-foot southernmost peak which on the chart was

marked active, for reasons best known to the cartographer. It did not even intersect Narborough, which, exactly one hundred years ago, had given Morrell such a warm reception.

On our visit two years ago to these islands we had hoped against hope for some hint of volcanic activity, with the same chance of success that a ramble through an old cobwebby attic might yield some overlooked treasure of the past. We calculated the half-dozen historic outbreaks to see if any periodicity marked their occurrence, but all was useless and we experienced nothing but the dead cinders of a world's end.

With the present incentive to hope we cleared Darwin Bay at ten o'clock and headed a little south of west, steaming slowly over the calm water. James was on our port side, Bindloe to starboard, with Abingdon and Indefatigable dim in the distance. New soundings between Tower, Bindloe, and James gave us data for our contour map which was slowly taking form in the *Arcturus* laboratory, and a deep haul brought up a catch of strange deep-sea beings. On we went, watching clouds form and reform on the horizon, but never certain of their origin. Toward evening all the islands, after flashing the sunset colors vividly back and forth to one another, gradually withdrew behind misty veils woven from their deeper valleys. I put over a small net from the boom-walk and skimmed the surface for an hour. Then in the dark-room I watched the wonderful glow from the lantern fish which I caught,—little eruptions of

body fires which flashed forth to their small world signals for food, for warning, and for a mate. Then I went on deck and saw the unmistakable glow of the fires of earth, and with a great wave of emotion I realized that my "World's End" had become World's Beginning.

All through the night we steamed at half speed toward Albemarle and every hour I went up on the bridge and focussed my high-power glasses ahead. From that same indefinite glow I had seen at Tower the eruption took form and size, and at last separate, gleaming lights could be distinguished.

Not satisfied with a single wonder, Nature sometimes takes us when we are immersed in the glory of some great sight and adds unexpectedly another, an auxiliary marvel for good measure, as a hint of the overflowing richness of the cosmic storehouse. Just before dawn, when three of us were watching silently with all our eyes, a mighty shooting star struck itself alight on the rim of our atmosphere, and in a blaze of white comet-light, fell silently and accurately into the center of the lava flow. After the identical happening of last evening, this appeared more than cosmic, it seemed intentional, and for a few moments I think the state of mind of all of us reverted to that of our distant forefathers, when signs and symbols and portents regulated all of life. When the possible combinations of the temporal and spatial arrival of a shooting star be considered, it was assuredly an astounding thing that two such mighty meteors should have taken this exact course.

The penalty or the advantage of human experience in various parts of the world is to stimulate similes of antithetical relationship. I have often laid at anchor off a gentle land, and before dawn watched the twinkling lights of villages and isolated farms go out one by one. Then the grey dawn picks out the larger hills and darker woodlands and finally the lesser objects. Farm houses materialize and from each goes up a twist of smoke, while that from the villages merges and floats slowly off as a unified cloud. Such was my introduction to the first volcanic eruption which I had ever seen actually come into being. Although the outward view recalled only such homely scenes, yet never was there absent from my mind its tremendous significance (Fig. 26).

Before the sun rose, the shifting light wrought another small magic. The lights had gone, the smoke had curled up peacefully for a half-hour, when I began to see that it did not twist and thread up as from breakfast fires beneath chimneys—it billowed and rolled. Then the houses dissolved before my eyes and became conical mounds or smoking ruins; what might have been fertile hill-slopes greyed to cinders, dotted with the upright skeletons of tortured or dead trees. Another case-ment of the magic window of memory opened, and I was lying before a mud-caked grating with the Verdun sentry, looking out upon an identical landscape: a few smoking ash heaps where once was Fleury, a cindery pile and a score of scarecrow trees in place of the peaceful beauty of Hadre-

court and Douamont. Before this spell broke I went quietly down to breakfast.

When three miles off shore we sounded in a mile and a quarter, and even when within a mile of the coast we floated on a half mile of water. In a fairly choppy sea three of us dropped into a boat. As we approached the land we realized the landing was going to be difficult. Heavy surf dashed against the cliffs, or rushed madly over half hidden reefs. Here and there were calm lagoons backed by mangroves, but always guarded by deadly giant waves. Up and down the shore we chugged, vainly looking for an opening. Twice I almost made up my mind to jump and let myself be washed ashore, but decided on a final reconnaissance to the northward toward Cape Marshall. We passed deep caverns cut out of black lava and once a natural bridge stretched across a gap from which four sea-lions leaped down to have a look at us. A golden grouper snapped at our shining brass propeller, sharks cut outer edges with their fins about the boat, and once a baby devilfish as large as the door of my cabin playfully flipped one of his wings and drenched us with spray.

As with all coasts, the capes and indentations were visible only when we were opposite them and hence we did not see a delightful little cove until we had almost passed it. Turning sharply in, a flock of noddy terns, pelicans, and some brown boobies greeted us. As I was changing motor for oars in shallow water a dozen big black groupers rushed at us and bumped and bit at the oars and

keel. I have never seen such reckless voracity. From appearances it would have been dangerous or fatal for a man to have dived in at that moment. Bill Merriam thrashed at the head of one with a piece of canvas and it was torn out of his grasp on the instant. I poked at them with the boat hook and two seized it at once. Later a fisherman of our party caught sixteen here,—a good two hundred pounds,—on spoon or bare hooks, as fast as they could be pulled in.

Before I left the *Arcturus*, I had very carefully examined, with my number twelve stereos, the whole of Albemarle in sight, and mapped out a tentative route to one of the largest outpourings of gas. At the outset I was handicapped by not being able to indicate or speak of the two great mountains between which the eruption was in progress. So I gave these nameless mountains the titles of Mount Whiton and Mount Williams after the two gentlemen without whose ship and generosity it is probable that this volcanic outburst would never have been recorded. The former is the most northern on Albemarle and its height is unknown. Mount Williams is next, thirteen miles to the south and over four thousand feet high, which is apparently somewhat less than the altitude of its neighbor. Most of the activity was along the slope connecting the two mountains, the actual glow from the lava being visible in groups or lines rather high up near the ridge. But at hundreds of places all over the slopes were fumaroles, or cinder caves from which poured forth greyish white gases. A

few openings over the summit of the ridge were high and large enough to merit the name of crater. Nowhere could molten lava actually be seen in the daytime.

I chose as our objective, a place of active eruption about half-way up the slope of Mt. Whiton. We found landing an easy matter in Eruption Cove, after we had picked our way over the broken reefs of coral and lava which guarded the entrance. Lacing on high, hob-nailed, moose-skin boots and carrying nothing but two empty snake bags and a single canteen, John Tee-Van and I set out this bright morning of Easter Sunday on the worst trip we have ever taken together. I have lost more blood from falls in a tramp over the high Himalayas, I have suffered much more from thirst in wild desert places of India and China, and have been more exhausted from lack of sleep during treks where there was no safe place to rest, but for sheer meanness and general uncomfortable travel this was the worst.

We started briskly with a last call to Bill in the boat to take us off in three or four hours. Our goal was unmistakable, for the underground powers had fired up and vast masses of billowing smoke were pouring forth.

The going at first was not bad. We had landed near the shore of a river of smooth, black lava about a mile wide, which had flowed seaward between banks of a rough, sharp pointed, apparently older flow. It was astonishingly like an actual stream or sea of water which, in the twinkling of an eye, had

been transformed to a glassy jet substance. We passed over ossified ripples and swells and even curving waves with breaking tips so tissue-thin that light showed through them in a thousand places, and a slight blow of my hand broke off sheets several yards in extent, which clanged down into the hollows like steel falling upon steel. Sometimes we could pass dry shod like St. Peter over a wide stretch of calmer obsidian ocean, with here or there the fin of a shark or the head of a turtle protruding, or in a Jonahesque manner would chum familiarly with a mighty glass whale. Islands rose here and there, upon which perched great images of sea lizards and pterodactyls—all done in jet-black, molasses-like lava. It compelled steep up and down climbing, but was heavenly smooth.

Our fossil river grew smaller and soon petered out and we had to take to the real scoria; hellish rock froth which taxed our utmost strength. Imagine, if you can, a brobdignagian ploughed field and we two tiny ants essaying to cross it. But in place of soft and yielding earth, this was of razor-edged, needle-pointed clinker, sometimes steel-hard, again crumbling to a depth of yards. It was reddish brown and, unlike the obsidian river, had probably hardened slowly at the very surface. All the enclosed gases had thus had opportunity to escape, bubbling and blowing the cooling lava into thinnest crusts and skeleton rocks. The metal soil of this great ploughing was piled in pinnacles and mounds, brittle, sharp as knife-points and varying in size from a needle to a house.

At every step we crashed down through the mass as one might tread upon hill-sides of delicate glass, or we leaped unsuspectingly on a harder, steely stratum only to slip sideways or in turn bring down a lava slide upon legs and body. Often what appeared to be the softest turned out to be a solid boulder, and the consequent unexpected jar was more trying than a slide or slip.

We clung as much as possible to the smooth lava and by going somewhat out of our way were able to follow a narrow stream for a considerable distance. But sooner or later we had always to plunge into the red porous chaos. In ten minutes we were dripping and panting. The unclouded sun shone steadily down upon the sea of metal and soon there arose a reflected heat like the blast from a furnace. We headed steadily for the giant, out-pouring cauldron well up on Mount Whiton's shoulders, reorienting our direction every time we climbed out of a furrow. Minutes passed, a half hour, and I realized that the simile of ants applied to our speed as well as to relative size. The coast seemed to recede with disheartening slowness, while the cauldron was as far off as ever. I decided to halt a few minutes to rest and found that even this was impossible. The heat from the lava when we stood still was unbearable, pouring up into our faces and scorching through the soles of our shoes. Even when we could occasionally find a smooth piece of lava, the stones were too hot to sit for a moment. I humbled myself and altered my objective to a lesser crater half as far away as the

large one, and after another half-hour's ghastly toil I again surrendered and changed the angle of our progress to the southwest, toward the nearest, smallest fumarole out of which smoke and gas came.

Every two hundred yards we stopped for a moment, standing and shifting from one foot to another. I found that even a square foot of shadowed rock yielded a welcome coolness to my boots and feet, but we could not squat coolie-fashion, for every breath of air ceased below a height of three feet.

By the time I could distinguish the separate piles of scoria around my small craters and the separate jets of gas, the going got even worse, for now we found our path intersected with ravines and cross arroyos, the traversing of which was almost impossible. The last quarter mile I went ahead blindly, and when I thought I must have reached the fumarole I found my way barred by a steep, unclimbable cliff of crumbling lava, and far to the right a tiny spurt of smoke. Disappointed, I turned to the left and managed to surmount a thirty foot elevation composed of scoria, breaking as easily as crackers but of the hardness and sharpness of the steel residue of factories. Fighting my way just ahead of the avalanches of lava which I kicked down, I came out on a flattened summit, and went on ten yards farther. A glorious cool wind met me for a moment, then died away and the sun's terrible rays poured down, at the same time that twenty fumaroles in all directions gave vent at once to

spouts of grey gas. Without knowing it I had climbed into the heart of the small, nearest crater which we had chosen. To escape the hot, terrible breaths of gas I stumbled forward to the eastward rim where four holes were evidently inactive. In a moment I realized my mistake and that I had entered the influence of some more awful invisible gas, perhaps carbon monoxide. The glaring sun became darkened for me and a frightful nausea forced me back to where the visible but less noxious fumes dominated. Added to this, the heat from below made the sun's influence seem almost benign. With my handkerchief over my nose and mouth I picked out several small pieces of lava covered with a whitish, crystallized exudate. Down one hole I could see a deep, rosy glow, but I could not stand the torture a moment longer, and half slid, half fell down the cruel, scrap-steel slope, and calling John, began our journey without a backward glance. We were too exhausted to do more than choose whatever way seemed least terrible. Now and then, from the summit of one of the dreadful furrows we could see the *Arcturus*—a tiny dot on the distant blue water, describing a five mile circle as she dragged a mile or more of deep-sea nets. Our drinking water was gone long before we returned and when we reached the shore we could hardly talk and were crumpled up with sudden cramps. I have had more than one strange Easter Sunday walk but never one like this.

Two yellow butterflies, one large fly and a few spiders near the shore comprised the fauna of this

hell-like zone, while a single, daisy-flowered, aromatic shrub, and two half-burned cacti represented the outposts of plants or their forlorn hope.

As I lay on my back, half in the cool water, I heard the cry of a young pup seal, and in the cave of a tiny ravine just back of some mangroves I discovered the ideal nursery of the little chap. He hitched himself in, just out of arm's reach, as I approached. A hot breath of air struck on my neck and the quickened memory of the past five hours sent me quickly back to the coral lagoon, there to bathe until I left for the ship.

After eight glasses of water and a bottle of beer my aqueous equilibrium was restored and I studied the shore with the increased interest of intimate experience. I had acquired infinitely greater respect for the details of what met my eyes. I laughed when I thought how blandly I had chosen yonder crater far up on the slope as my goal, and then shifted to the comparatively tiny vent so near the shore, and which had proved large and dangerous enough to kill a hundred men in as many seconds, if they were to remain that length of time on the conical summit of the appalling gridiron.

I sought information from the best authority upon volcanos and at the outset was delighted to find the entire subject accredited in a most technical geology to a wholly heathen god of old—Vulcan. I felt that my own consummate ignorance of the subject was less reprehensible when I read, "For the present, volcanic hypotheses must work out their own destiny."

Years ago it was a terrible blow to have my theory shattered of a molten world, around which stretched a tissue skin of solid, cold rock on which we dwell, like mealy-bugs on an apple. With such a theory at one's beck it was so easy to picture the volcanic lava as simply flowing up through open pipes connected with this inner reservoir. But I have come to find an equal thrill in the more logical planetesimal idea, especially as it lessens in no way the possible number and extent of volcanic outbreaks in the future.

I like to think of the incentive to these miles-deep activities as residing at least in part in tidal stresses,—in the same pull of the moon as that which uncovers my tiny tide-pools. The great craters of Mounts Whiton and Williams are quite dead, choked apparently with solid plugs of lava flows, but the major part of northern Albemarle consists of the scoria, whose slow cooling, as I have already said, allowed much of the retained gas to escape, and left exposed the ploughed rock froth over which we had to toil. The porous character of this surface has precluded the blowing up of craters or ground in the present activity and has resulted in the intrusive type of irruption which I have described. The primary deep throat of lava flow must exist high up on the shoulder slopes of the two mountains, flowing thence beneath the surface, finding actual peep holes for the hot lava itself at scores of places, and sending forth the excess gases and steam through a thousand vents. There was a nexus of at least twenty-five of these,

each a foot or more in diameter, at the miniature cinder cone which I reached.

The fascinating thing about the solid earth theory is the action and reaction of heat and pressure on rocks. If we penetrate the earth below the effect of seasonal changes the temperature increases about one degree in every sixty feet. Hence if the air at the surface is 70° Fahrenheit, at a depth of a mile it would be 158° . Carried to the center of the earth, this would reach the exceedingly warm temperature of about $350,000^{\circ}$! But the check to this explanation of molten lava is that, with the depth, pressure also increases from the earth's own gravity, and pressure is an absolute inhibitor of liquefaction. So as soon as we have gone deep enough to obtain the requisite 2000° to 3000° of heat necessary to melt rock, we automatically have a pressure which prevents it. But when old earth slips and shrinks, and surrounding hard rocks creep and give room to uncountable threads of liquid lava, and when the six mile zone of fracture beneath our feet somehow achieves direct touch with that. three or four times deeper, and the old mysterious tidal gravity gets in its work, up comes the lava to stir us mortals to our very souls.

So this is the story of my Galápagos volcano, which came to my consciousness with all the unexpectedness, and appealed to my enthusiasm and appreciation with all the power, of a single marvel,—at least that is what I thought as I steamed slowly northward in late afternoon. The sunset was directly behind it, and as the change was



FIG. 26 — BIRTH OF A VOLCANO

Poisonous gas and steam ascending from slopes between Mount Whiton and Mount Williams



FIG. 27. CREW STAFF WATCHING THE VOLCANIC Eruption IN THE GALÁPAGOS

wrought imperceptibly from pink and salmon sunset glow to the scarlet and white of the lava fires, the cosmic splendor of the whole thing was overpowering. Whatever the theory of vulcanism, however learnedly we might discourse of lava and volcanos, light and the sun, the dominant thing was that we had been brought close to the very beginning of things,—and this could not be written or spoken, hardly thought indeed, but merely sensed as one stood apart in a lonely corner of the deck.

But this Archipelago, when it had once opened its heart to us who had learned to love it so, gave lavishly, with measure overflowing. As when to the volcano it had added the miracle of the shooting star and then duplicated this on the second evening, so all the imagination of our company combined could not have foretold what June the fourteenth was to bring forth.

This was just nine weeks later, when we had returned from a trip clear to Panama to replenish our stock of coal and fresh water. It was also on a Sunday, when the *Arcturus* was again steaming along the shore of northeastern Albemarle. The sun rose when we were exactly on the equator, and the day broke clear and cool, with a strong wind and current from the south. At seven o'clock when we were all at breakfast, the wheezy, tin fog-horn sounded from the bridge—a signal that something of interest was in sight. We all tumbled up to see a great mass of steam pouring out apparently from the very sea beyond Cape Marshall. For two days we had watched from a distance the

gas and smoke from the same craters and fumaroles which we discovered two months before. They hung in a dense, sickly cloud around the flanks of Mount Whiten, lower and yellower than the clean cloud wreaths which formed around the summit. During the two nights of observation of our former visit we had seen several new vents of lava light break out lower and lower on the slopes. And now the god or goddess of Great Desires had granted what must have been a powerful longing in our minds (I can answer for it in my constantly recurring thoughts) and after an interval of more than two months we were favored by being on the exact spot at the right hour; at last the living lava had reached the sea and we were the only witnesses in the world.

The Captain had first noticed the white ascending masses in the distance at six-thirty and thought it might possibly be spray thrown up over the rocky tip of Cape Marshall. Half an hour later, when he knew this could not be so, he trumpeted for us, and, bucking a strong head wind and a two-knot current, we steamed steadily ahead. I climbed to the rolling crow's-nest and in a wind which almost pinned my eyelids open or shut, I watched the puffing masses of white grow larger. For the first hour there was little change, and I utilized the advantage of my position as from an airplane, to watch the surface life of this deep blue water five miles off the coast of Albemarle.

Two or three large rays came flapping along—not the full-grown giant devilfish, but half-grown

youngsters of the size only of an ordinary door and not a double barn-door. Now and then a sealion or two stood upright, half out of the water, gazing at us mildly, like stout little Balboas. The most wonderful sight was three huge *Mola*, or enormous sunfish. I had read, and seen pictures, of these massive monsters but this trio was the first in the flesh; and what flesh! They were devilfish stood on edge—oval masses, with tall dorsal fins, swimming upright, now and then veering enough to show the vast expanse of their vertical sides. I have seen replicas of their proportions in tiny half-inch larval fish which come sometimes in the surface trawls—unbelievably large around in proportion to their thickness (Plate III).

When Linnaeus first saw one of these sunfish he seems to have exclaimed, "*Mola mollium!*" Millstone of millstones! And so ever afterwards, even until today, "Best Beloved," every ichthyologist repeats the exclamation "*Mola mola!*"

My recipe for making a *Mola* would be to take some enormous fish, of normal body outline, and chop it off just behind the short high dorsal and anal fins. Let these grow around the stump until they meet, and behold, a *Mola*.

Nearer and nearer came the volcanic outburst—ever more wonderful and awe-inspiring. We steamed as close as we dared, then turned and circled past again. This we did four times during the afternoon, then lay off-shore and made a last revolution after dark. At each perihelion we brought to bear our batteries of eyes, glasses, still

and moving-picture cameras, and time after time, as the curtain of distance was raised, we felt we had front row seats at the most thrilling drama in the world. The current and the strong on-shore wind raised a sea which made launching a boat unthinkable—a bitter disappointment to me, who would have been glad to take greater chances than this for the opportunity of landing farther up the shore and approaching as near as possible (Fig. 27).

This was made doubly hard to resist when I looked along shore to the southward and there, only a few hundred yards away, saw the selfsame little mangrove-guarded cove where we had landed on Easter Sunday nine weeks before. The waves precluded repeating our visit, so we could only look with longing, and swing around for another broadside view of the new glorious outburst.

As we came closer, the amount and extent of up-pouring steam increased, actually as well as from the apparent change due to proximity. I noticed that there were irregular repetitions in its character. First a tremendous spurt of white, billowy steam would rush up into the air, tumbled and tossed landward by the strong wind; this would grey rather abruptly into a darker gas, then more steam, and so on. Seen dimly and at intervals through the steam, the high dark lava cliffs and levels showed for a considerable distance the same white incrustation of crystals which I had found around my fumarole on the inland slope.

Seizing a moment when the crow's-nest was comparatively steady, I swung my glasses along

the line of juncture of steam and water and saw a curious red tinge upon a sloping rock. It was badly blurred, however, and I carefully cleaned my eye-pieces, and then saw that the red was fire and the blur was movement—and in the full light of the sun I watched an open artery of Mother Earth pouring into the sea—rock liquid as blood. The Galápagos were being born again.

Even at this early stage I fortunately realized that this wonderful dénouement of the April outbreak was only two hours old, and I watched the development and change of the various phases with a far more appreciative appraisal than would otherwise have been possible.

For example, when we first passed close along the whole front of eruption there were but six vents or rivers of lava, but before we left there were nine and a possible tenth. The outpouring steam and gas was at first about what might result from an enormous, shell-struck ammunition dump; the next time we circled near, it had quadrupled, and before dark it stretched out in a gradually enlarging cloud as far as the mid-slopes of Mount Whiton—a distance of at least eight miles.

Neither by day nor night was there any trace of live surface lava nearer than a mile to this coastal outbreak. A geologist would have calmly explained it as "An instructive example of an intrusive irruption changing into an extrusive eruption." But all a geologist permits himself when commenting on a volcanic eruption is the perfectly safe statement, "When molten rock is forced to the sur-

face it gives rise to the most intense and impressive of all geological phenomena." My pity goes out to the student of earth and her rocks who has never yelled with sheer, unscientific, inarticulate enthusiasm at flowing lava, or been silent with awe at such a sight as confronted us.

When I recovered from the first great wave of realization of what good fortune had brought us, I perceived the astonishing details. The lava had crept slowly, week after week, down the slopes beneath the surface until it finally reached the end of the island flow. The amazing color of the whole was the most outstanding feature; the smoke, as I have said, was white and grey, the dead island jet-black, out of which spouted scarlet and white hot lava into water of unbelievable color. The sea around us and everywhere beyond the influence of this sudden eruption was a deep indigo blue, spattered and capped with white. When we first approached the lava streams, there stretched out into the blue water a narrow neck of clear, pure lumière green, enlarging at once into a shape which, from the crow's-nest, was exactly that of an old-fashioned powder-flask. For a time the Captain demurred about approaching this area, so perfectly did it resemble the green of extremely shallow water, but when within a hundred yards we could see that the surface agitation was the same as that of the blue water all around, and we knew its tint was due to some other cause. I have never seen two colors marked in liquid by so sharp a line. The normal temperature of the surface water off north-

east Albemarle that morning was 76° . When we reached the boundary of green water most distant from the eruption, I had Jay Pearson take temperatures as fast as he could pull up pailsful. We were barely drifting at this time so that his records covered a very short period of time and space. When we were nearest the shore, although still more than three hundred yards away, the green water had risen from 80° to 99° Fahrenheit. At this point we left the zone of influence and passed into the blue water. At the moment when the line of color was amidships the water under our stern marked 99° , while that at the bows registered 78° , a difference in less than two hundred feet of twenty-one degrees.

I examined the heated water carefully but found no sediment or suspended matter. A small tow net drawn through it for fifteen minutes took only a single blue copepod, a small *Coryphæna* or dolphin fish and a few tiny shrimps, all of which were alive and well. Unless there was some inorganic matter so fine that it showed no trace in a fresh or a long-standing glass of water, the sharp color demarcation was due only to contained air or gas plus increased temperature.

The streams of lava poured out of openings several times their own diameter and soon formed for themselves chutes of blackened, partly-cooled lava. From time to time these nearly closed over their streams so that three-fourths of a pipe was formed, then as quickly the pipe would melt and the great torrent stream out through the air unsup-

ported except by its own momentum. One spout of lava cooled so quickly that twenty feet from its appearance, great blobs of black appeared floating on its surface—irregular, cinderous corpuscles tossing on this veritable vein of molten metal. Once I saw a great lava river split into five separate streams, which crawled down the hundred-foot cliffs like the tentacles of some huge scarlet octopus. These dripped down into the boiling green water, while sulphurous fumes bubbled up in yellow froth.

There seemed a strange sort of irregular sequence of force. First one stream would increase, pulsating forth with greater violence, and immediately the sea would answer by catching great quantities of the scarlet fluid and moulding them instantly into gigantic, black bombs whose inner gases would explode simultaneously, and shoot forth a rain of half solid, half liquid boulder spray, the jagged projectiles trailing comet-wise, fire, gas and water in their wake. Then the steam from this particular jet would billow up above all the others, until a neighboring lava river in turn flooded its banks.

We were close enough to see every detail, but the fierce on-shore wind muffled every hiss and roar, every bubble and crash, and we might have been looking at the reproduction of some of the movies we were taking. From time to time, a huge portion of cliff would seemingly rise a little, tremble, and very slowly and gently topple forward, sending up a mountain of spray which alternately crashed in great breakers against the living and

dead lava, and boiled and bubbled like some brobdignagian kettle. It was astonishing to see a swell roll shoreward, curve up into a yellowish green wave, shatter against the scarlet lava and instantly rise and go floating off high in air toward the top of the distant mountain. It was a battle, a cosmic conflict among fire, water, earth and air such as only astronomers might dream of or a maker of worlds achieve.

Here at last was the very life blood of this Archipelago. Never would the black cliffs seem cold and meaningless again, but always memory would warm them and give them movement and color. Their twisted strands, their broken, porous bombs would seem to have cooled and exploded an instant before; every gas-made tunnel might redden and fill and pour at any moment.

I tried to estimate the speed of the lava and chose a stream about twenty feet wide. As well as I could judge at a distance of several hundred yards the cliff at this point was about a hundred feet high. I timed occasional black gobs of matter floating down the trough and found that they traversed the entire drop in two seconds. Therefore (as my old arithmetic used to say) "*if* a stream of lava flows a hundred feet in *two* seconds in *one* hour it will," etc., etc., etc. My answer was that the lava flowed thirty-four miles an hour. Here was liquid lava in the open air and in a strong cooling breeze holding its two to three thousand degrees of heat for a long distance, showing no blackening before it was lost in the mass of steam and water.

What the temperature must have been underground to instigate such a cauldron is unthinkable.

The yellow froth near the shore seemed to indicate a considerable amount of sulphur and I knew by experience that those grey gases alternating with the steam were in part at least composed of hydrogen sulphide and carbon monoxide. I liked to think of the lava as causing real additions to our upper world—new volumes of hydrogen and carbon dioxide actually spread abroad in the atmosphere for the first time, and, before our eyes, rock substance changing from white, to scarlet, to pink, and to black, which since the beginning of the world had lain miles deep within its heart.

I have dwelt on the inorganic activity but, from the very first glimpse we had of the eruption, animal life was everywhere in evidence. Within two hours of its beginning, action and reaction had begun, direct and indirect effects on a host of creatures. A veritable black wave of fish passed us soon after we entered the green water—a school, or better a mob, of great tunnies, swimming close together with all their strength, panic written in every movement, headed for blue, cool water. Close to the gangway floated a great octopus, a yard long, half dead, his tentacles feebly moving, with waves of vivid color coming and going over his flabby body. A few small fish drifted by on their backs, and writhing, twisting sea-worms. In a small boat I could have learned much more of the effects of this rarest of rare phenomena.

Birds, to my surprise, were the dominating fea-

ture. While still a long distance away my glasses showed what I took to be shrapnel-like projectiles flung up and dropping down in the steam and lava. When closer, I saw that these were frigatebirds and shearwaters, not, to be sure, diving into the boiling water, but exceedingly close. Instead of the roar and rush of the unusual clouds of steam frightening away the seabirds, the sudden manna drew them in numbers, just as, when I use dynamite in collecting fish, the vultures of the sea gather at the first glimpse of a floating silver belly.

As best I could I made a census of the immediate eruption area and counted over two hundred and fifty stormy petrels, many in the dark phase, lacking the white rump. There were seventy-eight shearwaters of at least two species, thirty-six frigatebirds, ten brown boobies and three pelicans. Not only were they in the outer zone of green water but a dense flock was flying close in shore about the lava. All were attracted by floating fish or other organisms, and often I saw them actually become obscured by the steam and gases. Later two dead petrels and a shearwater floated past, so that some at least paid a price for their reckless search for food.

At the height of interest in this marvellous sight, but when we were at the aphelion of our circle, I watched the sea-birds through glasses and learned some facts new to me. The shearwaters not only flew in their usual erratic flight and snatched a morsel here and there from the surface, but they skimmed the surface with their beaks, ploughing it

like skimmers. Besides this they flew actually into and through the high waves, working both feet and wings under water and often turning completely around before they emerged with tiny fish in their beaks. The wings flapped more rapidly under water and the feet paddled like mad. Every bird of the eight or ten near the *Arcturus* did this again and again, so it was in no sense an individual peculiarity. One shearwater was completely immersed for shorter or longer periods, seven times in nine minutes, and at the end the plumage seemed as dry as ever, and the flight was in no way heavy or impaired.

The greatest tragedy we saw was a full-grown sea-lion which suddenly leaped high, close to the shore. Five times he sprang, arching over eight to ten feet clear of the seething water and in blind agony headed straight for the scarlet delta of the lava. There was no final effort,—the last leap apparently carried him straight to death (Fig. 28).

At sunset we stood slowly in toward shore for a last look at the miracle which had been wrought for our benefit. I sat upon the very point of the bow and the sight which came to me from either hand might well have been from two different planets. To my left rose the long, sweeping slopes of Mount Williams, quiet in the sunlight, old, grey, dusty-looking lava alternating with masses of green cactus and bursera, while the shore was picked out with brilliant green mangroves. Clean, fleecy, unhurrying clouds drifted gently past the mountain's summit—Galápagos in her usual mood.

On the right, hell was let loose, a round worthy of Dante's lowest explorations—black, sinister crevasses, rushing steam, swirling ugly gases which swept on and on and finally joined the great noxious cloud which contaminated the clean mantle of Mount Whiton. In the foreground were scarlet, dripping lava and snarling bursts of gas-tortured bombs.

Dusk softened all this,—the gas vanished into the night and the nine lava streams became things of infinite beauty. The flying projectiles from the explosions were now seen as glowing red, not black. We turned and steamed toward James, and until ten o'clock that night, many miles away, the unforgettable fires burned over our stern. It was a wonderful farewell,—the very rocks of Galápagos alive.

Two things remain to be set down.

Twenty hours after we steamed away from Albe-marle, our steering-gear, without a second's warning, broke down. Twenty hours earlier, with the violent on-shore wind and current, deep water up to the very splash of the lava,—and the good old wooden *Arcturus* would have contributed a new odor and a few flying sparks, and after that the steam and gas would have continued as usual, and the lava flowed uninterruptedly.

And now that I have had to reread all these words in hard type, I realize that I have given no more idea of the real happening than if I had attempted a description of the single peacock, the one opal, the solitary sunset which I had seen and you had not.

CHAPTER VI

OUR ISLANDS

BY RUTH ROSE

BILL MERRIAM was shouting from the foot of the gangway.

“Hurry up! the boat’s ready! Come on!”

The anchor of the *Arcturus* had hardly splashed rustily into the placid waters of Gardner Bay when our flock of small boats splashed after it, and most of our land-hungry members eagerly sought for places in them. Soon the steep slope of white beach that fringes this side of Hood Island was dotted with exploring figures, scattering up and down the shore or vanishing into the thick scrub of the crater-side.

But even after weeks at sea, there were some of us who had decided to forego a shore expedition, at least until next day. During all our cruise I had listened to other people’s fish stories, which is not meant in a derogatory sense; I had admired the shapes and colors of the fish caught by others, and had marvelled at the sizes of the ones that got away. But alone of the staff, I had never gone fishing,—not only on this expedition but in all my life. So under the kindly tutelage of Betty Trotter and

FIGURE 25.—LAVA FROM THE ALBEMARLE VOLCANO POURING INTO THE SEA. KILLING FISH AND SEA TURTLES.

The distinct line between the hot and cold water can be seen.





FIG. 29. OSBORN ISLAND BETWEEN GARDNER AND HOOD
Part of a herd of tundra seals on the shore

Bill, I had determined to sally forth today to catch a fish, not for science, possibly not even edible, but a fish caught merely for the sake of fishing. This much talked-of business had to be investigated and its thrills experienced.

So now, at the commanding tones that echoed from the ship's side, I hastily caught up a spoon that was not a spoon, a squid that was not a squid, and a large hunting-knife that was indisputably just that, and dashed to the little boat with its out-board motor.

In all the archipelago called Galápagos, there is no more beautiful spot than Gardner Bay. The wonderful shore-line of Hood Island, with a thousand fascinating coves, peninsulas, pinnacles and caves, shelters the smooth surface where rocky islets seem to float, like congealed drops flung off from the parent island when that was still a seething fountain of molten lava. The scars of the terrible searing floods that have poured over Hood, from summit to shore, are more nearly covered by vegetation than elsewhere in the group, and on this sunny April day the sea, sky and land seemed wonderfully new, a vivid picture-world that had not been created long enough to lose its delicious freshness.

The motor chugged us briskly to a sheltered cove, where Bill laid some deep plots against the lives and freedom of the crayfish in the shape of baited traps, and then we set off to the passage between Hood and Gardner Islands. At the moment which was mysteriously declared to be the

right one, Betty and I were bidden to throw over the spoons and to let out what seemed to me like several miles of line, and I was breathlessly embarked on my first fishing trip.

To begin by being breathless was a great mistake; I needed more breath than was available long before we finished. There is such a thing as a science in fishing, everyone asserts, so my very brief experience must be misleading. There are many strange things about the Galápagos, conditions that seem topsy-turvy to us, and the fishing must share in this abnormality, for the sport of angling in these waters seems to me to be mostly an endurance contest, in which the fisherman sinks from exhaustion or his boat sinks from the weight of victims, not to his skill and cunning, but to the mere fact that he can exert a few pounds more pull on his end of the line than they can on theirs. The real test of skill here would be to prevent the fish from biting. My idea of fishing as a sport, solely gained from one afternoon in Gardner Bay, is as follows; you throw over a large, wicked hook, which has an uncanny aptitude for turning and rending you, and a shiny, curved piece of tin; you unreel a lot of line, and wait thirty seconds. Your arm is then jerked out of its socket, which you take as a hint that a fish insists on fighting it out on this line if it takes all winter. Your tutor in the gentle art of angling then stops the motor, which saves you from being dismembered. You start to pull in the line, the fish registering violent disapproval and arguing all the way. The line is extremely harsh,

and no one told you that gloves are worn when fishing; at frequent intervals you strike yourself on the chin with the large knobby piece of wood on which you coil each hard-won inch. At last with a rush, a great ugly head, with gaping jaws, pops out of water alongside, and standing up, to the imminent peril of the boat, you give one mighty heave and sit down suddenly, sometimes on the fish, sometimes with the fish in your lap. Naturally you emit a few piercing shrieks during all this, to the intense disgust of your masculine companion. In the process of recovering the hook and spoon, which have often been entirely swallowed, you acquire several wounds, and if I were writing a brochure containing Hints to Fishermen I should emphatically say, "*Never, never* get your fingers into the gills of a grouper." Then you gasp twice, throw out the line again and proceed as before. Now and then a fish, that by rights should be dead, slides stealthily along the bottom of the boat and deals you a tremendous smack with his tail. That usually incites the rest of the alleged corpses to imitation, and you feel like a Pilgrim Father running the gauntlet in a distinctly unfriendly Indian village.

Our catch consisted almost entirely of groupers, —big mottled fish whose voracity passes belief. After a while we found that it was not even necessary to troll for them; from the stationary boat the hook and spoon would be snapped up before more than a few feet of line were paid out.

Betty hooked one large Spanish mackerel, which put up a lively fight, and between us we also caught

five hieroglyphic fish, beautifully patterned with cuneiform inscriptions that seem as though they must be decipherable.

Now this business of catching large, resentful, powerful fish as fast as the line can be thrown out and pulled in, is excellent exercise and, for the first few thousand fish, great fun. But after a while it does pall upon one. As I dodged the assaults of a hot-tempered grouper that was exhibiting every sign of repugnance for the boat and our society, I glanced above the level of the gunwale for the first time in an hour or two. We were drifting in the shadow of a cliff, and such a cliff! Sheer from the water it rose, a black rampart to whose most impossible declivities clung little flowering plants. At the very top, outlined on the cloudless sky, a yellow-blossomed tree lifted thin arms, and the clear whistle of a mockingbird drifted down. Within oar's length a tiny pocket on the face of the rock wall held a scanty nest, and the carnelian eyes of the fork-tailed gull-mother watched us calmly over her lava parapet. Just below, a low, deep cave bored into the base of the cliff, and the slow surge, creeping back, revealed glimpses of rugged walls, softened and colored with the myriad hues of bright sponges, starfish and anemones. Sprawled motionless across the top of the arched entrance, a giant black sea-lizard might have been either a fairy-tale dragon guarding his den, or the sculptured device of an artistic Prospero.

My lagging interest in angling died altogether and I looked about to orient myself. We were

between Gardner Island, the largest of Hood's satellites, and this cliff, which was the face of a jutting point on an islet between Gardner and Hood. Its height was as out of proportion to the diameter of the island as that of a skyscraper. As we turned back toward the *Arcturus* we crossed a shoal that projects from the south side of Gardner, where each big roller, as it piled leisurely against the obstruction, showed in its curling green arch a dozen groupers apparently enjoying the sport of surf-riding.

As soon as we climbed aboard the ship, I went to the chartroom to find out the name of Islet-South-Of-Gardner. We must have been the first visitors to take an interest in it, for on none of our maps or charts was it considered worthy of more than anonymous delineation.

Everyone knows the fascination of the miniature; witness the steady market for ship models and Japanese toy gardens. It is a kindred feeling that makes islands more attractive than continents, and the smaller the island, the greater its charm. Next day we were in the diving-boat in the lee of Gardner, and the Unknown Isle loomed across the intervening strait, looking more and more mysteriously inviting with every passing hour. By the time my turn came to don the mediæval-looking helmet and climb slowly down into the misty blue-green world of water, this apparently unimportant bit of land had become the most desirable spot in all the Galápagos. But something always happened to prevent a visit; no small boat was avail-

able, or there was something very pressing to be done, and after a while I began to go about murmuring, "*Je n'ai jamais vu Carcassonne!*"

It is a great thing to have authority on your side, so when the Director took an interest in Islet-South-Of-Gardner I finally reached it. One morning he and Betty and I were ferried over; we landed on a little lava step to which it was just possible to jump from the stern of the small boat. This was on the opposite side of the island from the cliff, and seemed the only feasible landing place, for to the left the shores were too precipitous, and to the right a long arm of boulders was partly covered by a turmoil of surf. No one expects to land on a Galápagos dryshod; it is counted a lucky day when an effected landing leaves you dry from the waist up. So we dripped moistly up along a series of zigzag shelves in the rock, until we stood on a level bit of soil. The whole islet, seen from this point, seemed to slope gently from the northern to the southern side,—from the high point of the cliff down to the boulder beach that buried itself in the sea. Here among big water-smoothed stones were other lumps,—some dark as the lava rocks, others yellow-brown, depending on whether the sea-lions had had time to dry since heaving themselves out of the surf.

From my short acquaintance with the race, I feel justified in generalizing to the extent of stating that sea-lions are nice people. From the chunky unweaned babies that can be tucked under the arm and lugged about, somewhat cumbersome

but very lovable, to the old bulls with bristly moustaches, who pretend to be dangerous but turn sheepish when outfaced, they are all amusing, and some of the most delightful hours in the archipelago I have spent in their society. So now I naturally swerved toward the bulky bodies sprawled in the sun, all sleeping as blissfully as though lava boulders made the softest bed in the world.

The first group that I approached was of mother and child,—the latter enjoying peaceful dreams in a small tide puddle, while the guardian parent, a few feet away, lay dozing with her chin propped on a keen-edged stone. I walked up behind them, sat down a yard away, and remarked gently, "Good-morning."

There was no reaction to this, except that the skin on the mother's neck twitched, as though my voice were a ticklish sort of fly. I repeated my greeting somewhat louder. The otter-like head lifted from the rocky pillow and slowly swung in my direction, and not until both eyes were brought to bear upon me did the full horror of the situation dawn upon her. With a mighty snort of amazement, she sat as bolt upright as a sea-lion can sit, and braced on right-angled wrists she stared transfixed. I stared back, for one of her eyes was a repulsive, sightless mass of mucus, the result of a wound, I thought at first. The baby had not moved, so I reached out and patted his little rump. He rolled over nearly on his back, waving a languid flipper, but when he saw me, he went into reverse and lumbered hastily to his mother's side.

After spending five minutes in deliberate inspection, she decided that I was too strange a creature to be a desirable associate and withdrew, her offspring shuffling laboriously behind her, to a more distant spot, where they sank down and instantly went to sleep again.

My next attempt to be accepted in sea-lion circles met with more success. Further down the beach there was a group of youngsters, with one adult female apparently in charge; as a sea-lion has only one pup at a birth, I could only suppose that this was a sort of *crèche*, where other mothers left their children under the watchful eye of a good-natured neighbor while they went out to do the fish-marketing. Here I was received, if not as an equal, at least with more toleration than before, and as children are notoriously less suspicious than their elders, these fat sleek pups believed in my good intentions. The nurse or mothers' helper or whatever she was, showed some uneasiness at my too-familiar approach and at last made slowly for the water with her brood in tow, but when I followed and stepped into the shallow tide-pool in the rocks, which was evidently a favorite play-ground, the young ones floundered around me, lifting their small whiskered muzzles to peer curiously into my face as I crouched, and unmercifully tickling my bare feet and ankles as they dived to investigate my submerged portions.

As I looked from one to another of the doggish faces, I realized that every one of these pups had something the matter with its eyes. A sea-lion's eyes

out of water have a dim, near-sighted look, and as they dry in the air there is often some whitish matter about the corners, but each of these babies had, to a lesser degree, the same affliction that had made that first mother partially sightless. I went ashore to investigate, and of all the sea-lions on that little beach there was hardly one, old or young, that was without this disease. None of us had ever seen this before, either on our previous expedition of 1923, or during the present one. Here was something like a leper colony, composed almost entirely of the diseased animals, although this apparent segregation was probably more accidental than intentional, a voluntary rather than a compelled ostracism. The most pitiful sight was a small pup that was quite blind. He lay at some distance from any others, seemingly as well-nourished as any of the healthier babies, so the law of Sparta is evidently not in force among sea-lions. He was more frightened than any of his fellows when I approached, and before I really touched him, he began to scramble frantically away, crashing among the stones so recklessly that I hastily retreated, lest he should hurt himself or stray too far away from the spot where his returning mother would expect to find him.

He was being taken care of now, but I wondered how he would fare when next year there was another pup, a new arrival that would claim all the mother's attention. However, his future was settled out of hand when Dr. Cady heard of this island isolation ward. Next day the blind pup was

secured for examination, and the disease diagnosed as conjunctivitis. How this was ever contracted by Galápagos sea-lions no one has explained.

In fiction certain conventions are always observed by castaways upon a desert island. The first thing they do is to make a circuit of its shores, attaching names to various bits of geography as they go. Wishing to do the thing according to the best traditions, Betty and I set off to explore the coast-line. The Director was just visible in a tangle of scrub half-way up the cliff, and from his immobility we knew he was watching some creature, probably a nesting bird. At such moments in the life of a naturalist, the advent of spectators is seldom hailed with enthusiasm, so we discreetly left him to his observations. A few steps beyond the boulder beach brought us to a steep rock slide, worn glassy smooth by the sea-lions that had glissaded down its slope. Descent was easy, merely an imitation of the sea-lions. We landed at the foot of a cliff, where a big black lizard was spread-eagled against the lava, looking like a skin pegged out to dry in the sun. Our somewhat hilarious arrival disturbed him and he straddled up the face of the cliff, clinging to invisible projections with strong curved claws. Just to prove that we clawless beings were not wholly incapable of acrobatics, we swarmed after him and caught him by his thick, serrated tail. Once captured, he hung limply in our hands, resigned to fate, and even when replaced on the cliff, he remained quiescent as though incredulous of his good fortune.

The *Amblyrhynchus* of Hood and its surrounding islets is not of somber, unrelieved black, as are most of these marine lizards of the archipelago, but is irregularly streaked with dull red in varying quantities. The simile that occurred to us at the time was of a neglected rusty suit of black armor; a few weeks later and we would have said that the lizard repeated the tones of a volcanic eruption, seen in full sunlight—the old, cold lava for a background, trickled over by streams of molten lava.

Along the shelving shore ran a narrow path, a ledge cut in the coarse red rubble. It looked like a mountain-side sheep trail, and on one of the larger islands we would have supposed it to be a goat thoroughfare. But when we had to climb over boulders that jutted across the foot-way, since there was scarcely two feet of space beneath them, it was easy to see that no creatures of goat's stature ever wore this track. Below, the creaming surf whipped round a thousand little crags and promontories, where pompous pelicans watched for delicacies and took off clumsily in pursuit of them. Big scarlet crabs spangled the black rocks, and vermilion-throated sand lizards scampered after insects. The path dipped steeply and stopped at a pebbly beach, shut in all round by high rock walls. A tiny pool, left by the tide that had crept away through some invisible crevice, was occupied by a half-grown sea-lion, and a few yellow-tailed fish that were too small to interest him.

By this time we had worked round toward the lofty side of the islet, so that the land side of the

beach was faced by a sheer high wall. And in this wall was a low-arched opening, as black within as without. Not daring to hope that it would be anything more than the merest recess worn by the waves, we entered. To our delight (for what could be more satisfactory than an unexplored cave on a desert island) it was a narrow passage that turned sharply from the entrance and seemed to continue for some distance. At first we could stand erect and walk over a thick strewing of round pebbles, but presently in growing darkness the roof came down so low that we took to all fours and crept along a tunnel, dimly lighted now and then through fissures in the rock wall, opening at the level of the sea outside. A flickering greenish light, cast by the reflection of the sun on shallow water, made our crepuscular worming even more eerie than it would have seemed in total darkness. The silken sound of the wavelets slipping over stones inspired us simultaneously with the thought of the tide, and in involuntary whispers we discovered that we did not know whether it was rising or falling. Somewhat reassured by the recollection that this was no Bay of Fundy or Mont St. Michel, and that we should probably have sufficient warning to escape from these confined quarters, we crawled on. Presently the roof sloped up again, so that we could thankfully rise from bruised knees. It was very dark now, but stretching up and to both sides, no walls or roof could be reached. We turned round a slight angle and came suddenly into a large chamber, where at the further end a mys-

terious beam of light fell across a snow-white dais.

Rider Haggard could have done no better. As we stood stock-still hardly venturing to breathe, the consciousness of things moving quietly all about us was conveyed by more than the sense of actual hearing. Soft sighs, the rustle of a displaced pebble, a queer sibilant little sound between a breath and a hiss, peopled the gloom and sent tingles up and down our spines. Wild thoughts raced through our minds,—gnomes, mermaids, strange island folk of unhuman ancestry, or something too weird to imagine with even so much definiteness. Then a warm, wet nose sniffed experimentally around our ankles, and almost before we had time to realize that our cave trolls were sea-lions, and the white throne a wave-washed pile of pebbles and coral, there was a clatter and tinkle of stones, like faint cymbals and timbrels, and into the beam of light across the pale divan came the biggest sea-lion I ever saw. The circumstances and surroundings conspired to make him even larger than he would have seemed in daylight, I suppose, but he was assuredly the great-grandfather and the king of all his kind.

He advanced to the exact center of the spotlight and posed there. It seemed as though some one ought to cry "Oyez! Oyez!" but the only sounds were the subdued sighs under our feet and further back in unseen recesses the sibilant noises made by suckling pups.

The chamber was partially divided by a low wall running down the middle and we leaned on this

barrier, occasionally clutching each other to express our utter satisfaction. The light came from a sort of chimney-hole high up in the seaward wall, and on a shelf beneath the aperture lay a sea-lion, for all the world like an electrician in charge of a theater spotlight perched in his little box halfway up the proscenium arch.

The king seemed quite unaware of us until we slowly approached the throne; perhaps we did not observe the ceremonial proper to such a progress. Suddenly the patriarch emitted a terrific snuffling bellow and hurled himself straight at us, to the accompaniment of an avalanche of stones. Outside we should have known that he was harmless, but this stage setting was too much for our nerves. With muffled howls we threw ourselves prostrate on top of the dividing wall, hastily elevating our feet, and the monarch of the den thundered past. The complete humility of our concerted salaam should have placated him. We heard the echoes of his indignant wheezes dying away down the tunnel, and with a flop the royal electrician deserted his now useless post and shuffled in pursuit. This was the beginning of a general exodus. The harem, or courtiers, did not seem afraid of us; but it was perhaps court etiquette to follow the royal suit. In five minutes we were in sole possession of the audience-chamber, except that from corners too deep to be penetrated by the dim light still came the sound of happily-nourished infants.

We introduced the note of a Christmas pantomime into this equatorial fairy-tale by leaving

through the chimney, which was a scramble and a tight squeeze before we emerged on a rock platform halfway up a cliff and blinked in the blaze of sun. Feeling the combined sensations of Ali Baba, Tom Sawyer and the first explorer of cave-dwellings, the thought that made our enjoyment the more keen was that in all probability our feet were the first human ones to explore this island. There have been plenty of visitors to Hood, and scientists have collected from Gardner as well, but so far as we know, no one ever troubled to investigate these smaller islands of lava. Pirates and whalers, of pre-scientific days, might have landed on them, had they wished, but those strictly utilitarian gentlemen would have had no reason for doing so, though the sea-lion cave would have been an ideal hiding-place for treasure.

Continuing the circuit, we paused in some tide-pools, where we earnestly attempted to capture the wariest small fish I ever saw. A blue-footed booby watched us superciliously from an over-hanging ledge, with an air of I-could-an-if-I-would. Presently our fruitless efforts were interrupted by shouts, and the Director rushed to join us, all agog with the tale of a marvellous cave that *he* had discovered. We gave an imitation of the booby's expression, and explained carefully to him just what he had missed by not being with *us* when the cave was really discovered, instead of merely following in the footsteps of the pioneers, and finding that civilization had driven out the aborigines.

From a jutting headland we looked down to the

sea over a straight drop, a wall which gradually rose to the eminence of the cliff which had first attracted me to the island. Prospero's cave was not visible from this point. The air was sweet with the odor of a shrub with racemes of greenish-white flowers, and three or four bees hummed over the lures. These bees and these inconspicuous plants were the Galápagos manifestation of tropical luxuriance, the best that the islands could produce. There were many small, drab moths, and some of the low, pale-barked trees were almost leafless from the depredations of little green measuring worms, presumably the larval form of the moths. A small-billed finch was patiently stuffing her clamoring full-grown attendant youngster with as many of these worms as her careful search disclosed.

Entomology in the Galápagos must be pursued by painstaking examination of every leaf and twig, hole and corner, crack and crevice. Turning over large stones is one way of collecting, and we applied ourselves to this grubby method, on the steep hillside among thorny scrub and cactus. Two large reddish centipedes were our first reward, a dubious delight to the non-naturalist, but most welcome to our collecting bottles, as the only specimens of an equal size that we had so far acquired had been by the fragmentary method of taking them from the stomachs of dissected hawks. The first scuttling rush of a tiny gecko was hailed with shouts, for these little lizards are rather rare on the islands, and we were doubly interested in seeing what differences there might be between those from this

lesser land and their brothers on Hood. Diligent search, interspersed with bursts of speed, gave us four geckos, and we saw three others that were too agile for our combined efforts. A hawk soared overhead, perhaps watching our pursuit of such edible morsels as centipedes and lizards.

In certain directions the Galápagos is a narrow field of research. For instance, if you have seen a hawk there, you can rest on the assurance that you have now seen every species of hawk to be found in the archipelago, and the same is true of an owl. Those bees whose busy wings buzzed companionably about us are the only representatives of their family on the islands. But on the other hand, of the black finches that are native here there are at least fourteen species (Fig. 29).

Several kinds of beetles, a nest of flying ants and one of termites, and a white, thread-like centipede were disposed in vials before the blare of the ship's whistle warned us to be ready to perform those athletic feats necessary to embarkation in the small boat. Returning with what we felt to be an almost complete collection of the flora and fauna of our nameless islet, we christened it Osborn Island for Professor Henry Fairfield Osborn, and fell to sorting and preserving our specimens for future study. The Director combed Osborn Island with especial thoroughness for the total bird census, and, to add to the scientific value of this humble chapter, I have prevailed upon him to condense some of his observations into Appendix A at the end of this volume.

But now we sighed for smaller worlds to conquer, for from the rocky shelf of Osborn Island we had had an enticing view of an islet of even less acreage. Attraction and size seemed to be in inverse ratio; Hood would certainly rank as a small island; it is quite invisible on most world maps, but when anchored off its shores it loomed large, with the majesty of a continent, since the eye could not compass it at a glance. Probably I ought to be ashamed to admit that I never set foot on Hood during all the time that we lay in Gardner Bay. Gardner Island, a sort of New Zealand to Hood's Australia, held something more of island lure; the key to that fascination must be the hope that one may more fully possess it through a fuller knowledge, which is, after all, the only real kind of possession. Osborn Island had drawn us with the promise of imparted secrets, and now there was a smaller scrap, of infinite possibilities, with a delightful definiteness of outline that assured us of complete results in exploring.

At dawn next morning the patient doctor was routed out; he and one of the motor-boats understood each other, and he was accordingly elected to the position of the most popular ferryman. He displayed the spirit of a true Christian about it, and while he nourished the engine with gasoline, Lin, Betty and I raided the galley for our own sustenance. The baker, a fat man with a grim face and a kind heart, thrust a slab of coffee cake into our hands, adding a festive touch to the humble bread and butter to which we helped ourselves. A can-

teen of the rather highly flavored water which was the best the condensers could distill completed our modest ideas of a picnic, and even before the early breakfast hour the fussy sputter of the outboard motor was profaning the crystal stillness of the bay. A grey sky slowly burned to blue at the zenith, while all round the horizon streaks of color brightened and faded. The smooth grey water looked so solid that the boat's prow seemed to carve a way through a leaden sheet that fell back in long wrinkles.

Our splashy landing on a submerged ledge did not even wake a half-grown sea-lion from his beauty sleep and with a sympathy in our hearts born of many reluctant risings of our own, we left him in peace. The receding gasps of the motor were swallowed up in the vast quiet, and as the first cool sunlight touched our Terra Incognita, we sat on a patch of scanty grass to breakfast, and tossed crumbs and crusts to a perky mockingbird and a big scarlet crab that hopped and sidled round us.

Near at hand were tide-pools where tiny bright fishes hurried about and maroon-and-pink anemones closed flabbily over my intruding fingers. Following the northern shore, we climbed along a rapidly rising series of huge steps roughly formed of crumbled rocks and reddish, friable earth. Over the edge of the cliffs we could catch glimpses of cosy homes tucked away in miniature caves or on hollowed ledges, where fork-tailed gulls and noddy terns were bringing up their families, and cocking

unconcerned heads at the apparition of our interested faces appearing from above, usually upside down. A beautiful little red-footed dove fluttered from under our feet, and added to her plump, partridge-like appearance by simulating a broken wing in an attempt to lure us from the two white eggs lying under a boulder on a heap of twigs.

Presently we came to such a barrier of thorny scrub that we went inland, still aiming for the highest point of Our Island. Its center was a cup-like depression sloping toward the sea, and here an incongruous memory smote me. The evenly spaced, low, gnarled trees, the seeded grasses growing long and rank beneath, the rocks lying in tumbled lines here and there, strangely resembled an abandoned New England orchard with crumbled stone-walls and once-cultivated air. There was even a sort of pit which needed only a sidewise glance to be a cellar, the forlorn remnant of a home, such as one finds on a country back-road, or comes upon in a short-cut across young timber-land. Surely an unexpected comparison, for of all places in the world the Galápagos and New England are the least alike.

The sunlight was no longer cool, nor were we, as we struggled up the steep inner side of the cup, cut off from any breeze and lacking anything that could be called shade. A final scramble and we emerged on the pinnacle rim to a panorama that made us gasp. Far off was the misty loom that we knew for Chatham Island, twenty-five miles away, while close at hand were the shores of Hood with

YOUNG FISH TAKEN AT THE SURFACE IN MID-OCEAN

- FIG. A. Young of the Giant Sun-fish, *Mola mola* (Linné)
“ B. Young of an unknown Soldier-fish, *Holocentrus*
“ C. Young of an unknown Pomfret, *Taractes*
(Actual length of all three fish, one-half to three
fourths of an inch)



11 A



11 B



11 C

a lacy edge of surf. Gardner and Osborn, to the north and west, were little dark heaps speckled with faint green, and a toy *Arcturus* lay between them. Rounding the furthest point of Hood was a moving dot,—the launch returning from a visit to the albatross rookery. And everywhere stretched the empty miles of blue plain, the summer sea, ruffled by a lusty trade-wind that fanned our hot faces with sweet air.

The sweeping view held us so long that we did not for some minutes see what lay below. At our feet was a sheer drop of a hundred feet or more; a long jetty, a narrow rampart of rock, perhaps thirty feet high, projected from the island for some distance, and turned at a neat accurate right-angle to parallel the line of the cliff where we stood, so that we looked down upon a perfectly protected harbor, enclosed on three sides. It hardly seemed possible that man had had no hand in the shaping of this precise alignment, that might have been a miniature of some such famous port as Alexandria, where the populace sauntered on the mole and watched ships come and go. In this case the gossiping crowd was composed of boobies, jostling each other along the narrow wall-top or standing stiffly like sentinels silhouetted against the sea.

They had no ships to watch, but there was activity enough, of a kind that was as visible to them as it was to us from our loftier perch. At the surface floated an enormous school of the beautiful white-striped angelfish, *Holocanthus passer*, their black bodies, splashed with orange, red and purple,

plainly seen as they lay on their sides in the fashion peculiar to this species. We had seen them before by the half-dozen close about the small boats along shore, but there were hundreds in this group, drifting like bright petals in the clear deep water of the sheltered haven. Beyond the natural break-water a round dark object seemed to be a rock, just awash, until two flippers shot out to propel it forward and turn it into a huge turtle. A school of large carangids drove swiftly past like a cloud shadow, and the sharp fins of three sharks cruised aimlessly to and fro above the long, submerged bodies. Across the strait between Our Island and Hood came thirteen great bat shapes,—rays swimming with graceful undulations of their wing-like fins, and holding their places in accurate battle-squadron formation.

From our height the water seemed a medium scarcely thicker than air. Now and then a booby launched himself from his observation post, soared rapidly and fell like a stone in a breath-taking dive. A slight splash, the bird disappeared while you could count three, and then popped out like a seed squeezed from an orange. A few steps further on we reached the best place of all. Behind the jetty stood a rock pinnacle, broad at the base, flattened on both sides, with razor edges, and tapering to a point that was almost as high as our cliff. It was a gigantic arrow-head, standing in the surf, and connected with the island by a tiny causeway far down at its foot. The waves boiled in a narrow tunnel they had worn completely through the base

of this stone triangle, and on its very apex perched a lonely gull.

We sat on the brink of the precipice and with heads tilted far back, watched a frigatebird soaring overhead. There was something hypnotic in the unceasing song of the wind, the abyss below, and the vast blue vault above, empty save for a pair of outstretched wings that rocked lazily round and round a wide circle. At long intervals those wings flapped twice, then stiffened and held motionless, while the bird, confidently cradled on the rushing air, swung in its chosen orbit and watched its world. There was a dizzy moment when we too seemed to wheel in a great void, when, gasping, we clutched the solid rocks beneath, and brought our eyes, and so our bodies, back to the reality of finite earth and ocean, surf and sand.

Sometimes, in the confusion of cities, in the midst of the dirt and noise and countless irritations that make civilization seem a deplorable blunder, it is good to remember that a frigatebird is winging over that little secret harbor which, it may be, was never seen by any other human eyes than ours.

CHAPTER VII

WITH THE SHARKS OF NARBOROUGH

I ANCHORED the glass-bottomed diving boat as close to the cliffs of northern Narborough as I dared, in a cove where the water was so deep that the swells remained unbroken until shattered against the lava itself. The rocks at this point showed very clearly their division into successive lava flows, some like frozen, black molasses candy six feet thick, alternating with thinner strata in the shape of huge bricks. The topmost layer was the same old ploughed field of cinder crags and snags with which we were so familiar on Albemarle. This is probably the eruption of one hundred years ago of which Morrell wrote so vividly.¹

This, my seventieth descent, took me into a submarine world as strange and as unlike that of Tagus Cove (which we could still see in the distance from the ship), as that differed from Tower. If they were jungles and deserts this was a wheat-field. Swallowing as I went, I climbed down and down and stood, at last, on a gigantic rounded boulder, thirty feet below the surface. This roundness spelled a distinct difference between this and

¹ Galápagos: *World's End*, pp 401-405.

other shores of the Galápagos. The surf had pounded and rolled the rocks on this unprotected coast until they had become huge pebbles. This explained the absence of tide-pools along the shore—the water simply filtering away as soon as the tide level went down.

The dominant note of this under-water scene in this marvellous island eddy was the sea-weed. Great fields of it extended to the limit of vision, with bare or sponge-covered boulders between. Sargassum with small berries, grew on long, slender fronds, two or three feet in length, which gave completely to every surge, more so than any land growth to the wind. While I have dived where steady currents hold in one direction day and night, yet by the very force of circumstances, my puny efforts are usually confined to the surge-affected shore. Like a tide which changes every twelve seconds instead of every twelve hours, the whole underworld swayed outward and then, with infinite grace, inward again. All of the innumerable strands of greenish olive bent and flattened away from me, and then, with the slow movement attained only rarely by such growths as weeping willows, rolled toward and wrapped around me, reaching out toward the steep ascent marking the beginning of that upper world which seemed so little a part of my life at a moment like this. As the grass shifted and vibrated, many weird little inhabitants were disclosed for a moment, and then scuttled back to shelter—wrasse never seen before or since, twisting worms, crabs and snails, all iden-

tical in color with the weed. The numbers and size of the fish outside the weed were remarkable, almost every species being represented by larger individuals than elsewhere, due perhaps to the unusual abundance of food on these current-served shores. My old friends *Xesurus*, the yellow-tailed cows, were grazing in schools of two to three hundred, shadowing slowly about the corners of boulders.

I was half way up a steep slope, and by twisting the boat around with me I succeeded in reaching the summit, where I could look down upon a sinister valley, narrow and dark and deep, with the opposite ridge covered with the same long, waving weed. As I stretched full length upon a mat of the sargassum, a gang—they were too ugly and dangerous looking to call school—of giant groupers parted the fronds and drifted through toward me, all dark, in tone with the olives and browns. They mouched along, their ugly jaws chewing eternally on the cud of life, when suddenly, without the slightest warning, there came a distinct glow and next to the last grouper came one of the goldens. To their evident opinion there was no difference; he impatiently nudged a neighbor and in turn was pushed aside by the fish following him. The most careful dissection on our part shows absolutely no physical difference and yet, instead of being clad in mottled olive green of the dullest, darkest shade, he is solid gold from mouth to tail. The weed was appreciably illumined when he passed through it. One strange thing has been that, rare as these golden

groupers are, both two years ago and during the present trip, it is only these gorgeously colored individuals which attack the propeller of our little out-board motors. Whether the color of the glistening brass attracts this shining caste more than it does the other, duller grouper persons, I have no idea.

A few minutes later a shadowy school, a second lot, of even larger groupers swept past in the blue distance with another golden brother with them. He is all the more wonderful because there are no intermediates—one has either regal golden blood or mottled brown polloi caste. Here is materialized the mental effect which creates in fairy tales the one most beautiful creature or hero or princess among a host of dull or ugly ones.

Once again a huge sea-lion gave me a start. As I stood watching a mist of grazing *Xcsurus* I felt a sudden water pressure against my back and legs, and turned in time to see a monstrous black shape bank and veer away, having rushed down in a lightning sweep within a foot of me. His eyes were no longer the dull, soft, deer-like, half-seeing organs with which he gazed at me on land, but bright and clear and keen; the long cheek whiskers stood out white and bristling, the mouth partly opened as he turned and the dog teeth gleamed wickedly. As my eye caught his form I leaped involuntarily toward the ladder, forgetting that I was in a land where mighty acrobatics could be achieved with a mere push. I landed on a boulder at a height of about four rungs up, and some eight feet beyond the ladder—a standing high and distance jump which

broke the world's record in the upper air by feet. The strangest thing about it was that whenever I did such a thing as this, I accomplished it slowly. I took off with deliberation in spite of my strongest effort, I went through the water with conscious lapse of time, and I landed as in a slow motion picture.

The instant I leaped I realized my mistake and watched the wonderful form as it swung up from me. It turned just below the surface and again shot down. I think a considerable percentage of these manœuvres was pure side, executed for the benefit of a smaller, probably a lady sea-lion, who hung between earth and air a short distance away, and watched. The big male—he was certainly over seven feet long—began his second rush at an acute angle, heading for the bottom some distance away. Turning like a meteor the moment his head touched the waving seaweed, he again cleared me by inches. I could not help but flinch, not from a fear of being bitten but from a disbelief that such a great body could possibly stop its impetus and not smash into me. As he passed, I stretched out a hand and felt the smooth, hard body brush against my fingers. This was apparently a surprise to the animal, who, in alarm, inserted an extra curve into his simple parabola, and in the effort gasped out a mouthful of bubbles. This time he shot to the surface and half out, followed by his admirer, while the string of bubbles ascended slowly—coalescing as it went into larger and fewer spheres—like the puff of smoke from an airplane engine, or the

blossoming of white shrapnel against a blue sky. In each bubble I could see a distorted reflection of myself, my helmet and all my surroundings.

A glance around showed that every fish had vanished, and not until two or three minutes had passed did they begin slowly coming into view. The sea-lions are the masters of these waters, and I was surprised to see even a great turtle slide hastily out of the way when one came too near. Sharks always disappeared with the fish.

Even if the fish had not returned I could have watched the movement of the seaweed for hours, it was so unlike the movement of wheat or grass. The whole mass seemed alive—a field of medusa growth—each stem writhing and curling and twisting of its own volition, in its own particular way, and yet the whole ebbing and flowing as one frond in obedience to the rhythmic breeze. It was the old story over again of the single corpuscle tumbling and rolling individually while yet helpless in the general current of the blood; and of the colonial organism—each individual ant doing his own work although bound irrevocably to the will of the whole, and—who knows—it is perhaps no whit different from the apparent free-will personalities of our separate selves, compared with the destiny of the human race.

I sat me down on a couch of golden, blowing weed, with beautiful green-armed starfish sprawled here and there, and leaning back, watched the bubbles of my life's breath tumble out from beneath my arms and shoulders. From invisibility, from

the colorless, formless stream of gas flowing down the length of black hose, they became definite spheres, painted and splashed with all the colors in sight. Once, when I was making my first flight in a plane, I had, for a short space of time, the soul-devastating sensation of being suspended motionless in the ether while the earth dropped away from me. That has never been repeated, but here on the bottom of the sea, looking upward at the great bubbles of breath, I can often conjure up the belief that I am actually looking at a constellation, a galaxy of worlds and stars, rolling majestically through the invisible ether. The background is as mysteriously colorless and formless as space itself must be, and as I peer out through my little rectangular windows I seem to be actually living an experience which only the genius of a Verne or a Wells can imagine into words. It suddenly flashes over me that in giving over my moon and stellar longings for the depths of the sea, I have in a manner achieved both.

I have even the sensations of a god, for in each of the spheres I have created, I see very distinctly my own image. But I also see many more interesting things and my moonings in the present instance were brought to an abrupt end by a glint of gold which appeared on each globule of air—a fiery pin-point which became an oval and soon a great spot as if a sun were rising behind me. If I were looking at a real planet such a thing might be a tremendous volcanic eruption on the surface. Twisting slightly and peering obliquely through

my little periscope I saw what, after all, is the most joyous thing in life, an old friend in a new guise—another great golden grouper just behind me, revealed by his reflected image on my ascending breath.

To my left the rope from the anchor weight led up in a graceful curve to the distant, dark silhouette of the boat. Now and then a window opened in the ruffled ceiling and framed the anxious face of my faithful assistant peering down, on the lookout for approaching danger. The face vanished, the window slammed shut as the water-glass was withdrawn, and I was again visually lost to the upper world.

Two small, black forms approached from the off-shore side of my aquatic sky, looking from below, like the keels of funny, diminutive tug-boats, and driven by a pair of most efficient propellers. These were rather turbines of sorts, furling and unfurling in a curling, spiral manner, which offered the most and the least resistance respectively to the water. Long rudder tails, two slender, sharp beaks and sinuous snaky necks came into view, and a swirl sent both birds into my world—meaning complete submersion for them. There followed a chase which no man's eyes have ever seen before—a pair of flightless cormorants pursuing a scarlet sea bass—viewed from below. The fish saw them coming and fled at full speed, not in a straight line but in a series of zigzags, perhaps, like a chased hen, seeing the pursuers first out of one eye on one side, then out of the other apparently on that side. The

cormorants separated, one diving deeply while the other followed its prey directly. Soon the confused fish dived at right angles and before it had time to turn again was in the beak of the second bird. The moment it was captured, both birds relaxed every muscle and with dangling wings and feet let themselves be drawn up to the surface. There, even from my depth, I watched a second race begin, and surmised the details of what I had seen enacted twice the day before from the boat, a cormorant coming up with a fish and instantly chased by another, both travelling at such high speed, that with wings spattering and feet going, their entire bodies were almost out of water. At the first opportunity, a quick upward toss, reversing the fish, and a gulp, and down it went headfirst. On this occasion I saw only the frantic disturbance of the surface, rapid dodging, and then cessation of motion, after which the leading bird immersed and shook its beak in the water several times, and I knew that if I so chose, I could write in my journal that at Narborough, *Nannopteron harrisii* includes *Paranthias furcifer* in its articles of diet.

The surface ripples had hardly ceased when a cloud drifted across my little sky. And, parenthetically, at this place I digress long enough to make a certain point clear. As I ramble on of the adventures and sights which came to me in my underworld, there would seem to occur almost a rhythmic succession of happenings, one after the other, like the feats of circus performers who wait in the wings for their turn to come. This works

a hopeless injustice to this water world. Please remember that the exigencies of my place in that world, and the physical makeup of my helmet enables me to see only the merest fraction of occurrences even in an acute-angled single direction. A horse with blinders is a reasonable simile, or better still, an aged, half blind old man, crippled with rheumatism and palsy and dropped suddenly without warning into the busiest of a city's streets and requested to narrate the happenings about him, and give to them some sort of explanation!

Now again, the ripples of the surface above me had scarcely died away to the usual heaving, opaque, moonstone appearance of my water sky, when a cloud came drifting past. If I had been looking behind me some time before, and had eyes which could penetrate the wall of blueness in the distance, this cloud might at first have seemed no bigger than a man's hand. Overhead, however, it was large enough to darken the whole bottom, and, except along the rim, formed a solid mass. At least twenty thousand slender little Galápagos snappers floated over and around me. They were only two to three inches in length, slender and sinuous, greyish black above, silvery below, with seven or more narrow dark stripes running parallel down the head and body. This was the clear-cut vision I had as the host drifted slowly, almost without individual movement, toward and over me. Some danger, forever unknown to me, wrought a whirlwind in this living cloud, and instantly every fish vanished,—the whole becoming a mass of blurred

lines, a great grey something out of focus. As quickly, fear passed, and every fish again became clearly etched in its place among its thousands of fellows. Slowly all passed from view, a few hundreds along the lower edge sifting through the uppermost fringe of weeds. It occurred to me then that their man-given name was a singularly appropriate one—*Xcnocys*,—strange! swift! It should have been *Xcnocys xcnocys*; they were too delicate, too immaterial for any noun.

My sea-lion returned for a last look but slewed off, and then a turtle, almost as long as myself, swam into my ken. He was a much more satisfactory constellation than any in the heavens, of most of which I have never been able to make head or tail. But he was a turtle at its best. Until one has looked up and seen eight hundred pounds of sea turtle floating lightly as a thistledown overhead, balanced so exactly between bottom and surface that the slightest half-inch ripple of flipper motion was sufficient to turn the great mass partly over and send it ahead a yard—until then one has never really seen a turtle. Two years ago when I visited these islands, I watched the little penguins waddling about with their ever inimitable gait, I saw the cormorants awkwardly climbing over land, even hauling themselves along by means of crooking their necks, the sea-lions unlovelily caterpillar-ing along the ground, and great hulks of turtles ploughing their way as much through as over the sand of the beaches. It was now my privilege to see these same creatures in their chosen element,

graceful, glorified reincarnations of their terrestrial activities. In all of this I had no false illusions concerning my own relative functioning. While I have never heard any rumor as to my possessing any grace even at my best, yet on these same islands and beaches I can at least correlate my activity, and I can easily run down any of the creatures which I am discussing. Whereas here at the sea bottom I sprawl awkwardly, clutching at waving weeds to keep from being washed away by the gentle swell, peering out of a metal case infinitely more ugly than the turtle's head and superior to them only in my hearty admiration of their perfect coördination in an exquisitely adapted environment.

My pleasant turtle friend still floated motionless, when suddenly he was the means of my making a delightful discovery in Einstein relativity,—making clear the fact that he was motionless and yet not motionless. I was resting lightly on a bed of weeds with a generous tuft of them in each hand. I was aware that with every surge there was a very decided movement of the whole mass but as everything in sight was equally shifted my mind registered no definite motion. Of one thing only was I certain, that however we plants and organisms at the bottom were blowing and vibrating back and forth, the turtle at least, isolated in mid-water, was as still as the distant rocks themselves. Becoming cramped I decided to stand upright for a while, and gently lowered my feet until I felt them fit into convenient crevices of the concealed rocks

beneath me. This gave me safe anchorage, and in a minute more all my surroundings, my whole world, went trailing off as far as it could, then, with equal unanimity, all faithfully returned. I glanced upward and was as astonished as if when on land I should suddenly see the moon or sun begin bobbing back and forth in the sky, for my turtle was behaving like everything else and being swayed back and forth, suspended in the invisible medium exactly as we at the bottom. To look back upon it, no more silly lack of reasoning could be imagined on my part, but when you leave the world for which God made you and wilfully enter other strange ones, it is reasonable to suppose that your senses and brain have to become readjusted as well as your more physical being. For five minutes I derived infinite delight in alternately swaying with the weed, and holding to the rock, and thereby at will giving to my turtle absolute stability or rhythmical swaying through space. He seemed quite unaffected by the theory, but fascinated by the sight of this strange copper-headed, white-skinned, worm-like being, with an enormously long, curving tentacle from the tip of its nose, forever pouring forth a mass of white, bubbly gas, and which idiotically kept standing up and sitting down. Never for an instant did the great chelonian take his eyes from me. If I could put down what he actually thought of me no halting words of mine would be necessary in this chapter.

And still the turtle hung in the sky when two penguins arrived. For a time they swam around in

little intersecting circles, constantly plunging their heads beneath the water to stare at me. Finally curiosity overcame them, they could stand it no longer, and down they came, clad in mantles of silvery bubble sheen. They encircled me once, started on another round but then became fascinated by the black hose and after an examination, half paddled, half drifted to the surface and were gone.

Two mighty schools of *Xesurus* passed me grazing slowly. When within six feet they left off their eternal feeding and formed up into more or less orderly ranks which flowed like some enormously long sea-serpent around the identical corners of rocks where had passed the leaders, yards and yards in advance. Invariably the formation of an irregular line led very close to me, the closing up of ranks evidently being connected with the presence of danger or at least something suspicious or strange. It was an amusing sensation to have these hundreds of fish file past, all rolling their eyes at me as they went. I felt almost embarrassed at times, as perhaps "the remains" must occasionally feel as the viewing crowds stream past. With these yellow-tailed cows were widely scattered, single individuals of a fish which we never caught nor identified. In shape and in the general greyish blue color of body they bore a considerable resemblance to *Xesurus*, their characteristic marks being two white spots above the eyes. But they were not grazers, nor even, I believe, herbivorous. I never saw them graze even when the school of their asso-

ciates remained in one spot, doing nothing else for a half hour but scrape the algæ from the rocks. Once too, I saw one of these white-spotted chaps pursue a small fish, and though he did not capture it, yet I could not mistake his intent,—there was nothing of play nor yet of sudden anger in the attempt, but a very evident desire for food. They were much more timorous than the yellow-tailed surgeon fish and at any hint of danger would dart into the thick of the school. All this makes me think that they are very likely examples of real mimicry, gaining a good percentage of immunity by the resemblance to and close association with fish, which by their great numbers and poisonous spines are well able to fight off ordinary dangers.

When I rolled over and looked about, there came to me a vision of the abundance of life in the sea. The cloud of little fishes had gone, even the ubiquitous yellow-tailed surgeons were out of sight for once, and yet from where I sat I could see not fewer than seven or eight hundred fish, not counting the wrasse and gobies which played around my fingers as thickly as grasshoppers in a hay-field. Out of the blue-green distance or up from frond-draped depths good-sized grey sharks appeared now and then. Two came slowly toward me, closer with the in-surge and then floating farther off with the out-swing. They turned first one, then the other, yellow, cat-like eye toward me, and after a good look veered off. Near to them were playing round-headed pigfish, a few *Xesurus* swam still nearer, and even small scarlet snappers, the prey of al-

most every hungry fish or aquatic bird, even these went by without any show of nervousness. The pair of sharks passed on, almost unnoticed; and all the mass of life of this wonder world seemed going smoothly and undisturbed. Far away in the dim distance one of the sharks appeared again, or it may have been another—when, looking around me, I saw every fish vanishing. While I have mentioned what must seem an identical occurrence before, yet this was as different as a great battle is from a street accident. Through copper and glass and air I sensed some peril very unlike the former reaction to the sea-lion, and I rapidly climbed a half dozen rungs, swallowing hard as I went to adjust to the new altitude. Clinging close to the ladder I looked everywhere, but saw nothing but waving seaweed. The distant shark had vanished together with all the hosts of fish, even to the bullying, fearless groupers. I was the only living being except the starfish and the tiny waving heads of the hydroids which grew in clusters among the thinner growths of weed, as violets appear amidst high grass. Whether the distant shark was of some different, very dreaded kind, or whether some still more inimical thing had appeared—fearful even to the strange shark, I shall never know. Five minutes later, fear had again passed, and life, not death, was dominant (Fig. 69).

I climbed to the surface at last, my teeth chattering from the prolonged immersion. This water, although in no sense the Humboldt Current, is much cooler than that at Cocos and I become numb

and chilled without knowing it. Excitement and concentrated interest keep me keyed up, and the constant need of balance requires that every muscle is taut, and then when I reach the surface and relax, the chill seems to enter my very bones. Fortunately there is always either rowing or pumping to do and this soon warms me.

During my last dive I had noticed five or six new species of fish and hoping to hook some of the smaller ones I decided to get some bait. I had the boat backed near shore and at a propitious moment on the crest of one of the lesser swells I leaped off. The scarlet crabs here are remarkably tame, far more so than on any of the other islands, a fact for which I can in no way account. The casual visits of man may be of course ruled out as having nothing to do with it, and yet here birds and fish, the crabs' most deadly enemies, are unusually abundant.

With two big, scarlet crabs I vaulted back on the crest of another convenient little swell, fortunately just avoiding the succeeding three, any one of which would have tossed our cockle-shell high up on the jagged lava. I found to my disappointment that we had between us only one hook and that a large one. However, I anchored again near the spot where I had last dived and threw over the hook. I immediately caught one of the round-headed pig-fish, about a foot in length. As I was pulling in a second one, a six-foot shark swung toward him and this gave me a hint upon which I acted at once. I pulled in the fish quickly and studied the situation



11 30 MANTA OF CIANI RAY CAPTURED BY DICKERMAN, FRANKLIN AND CADDY

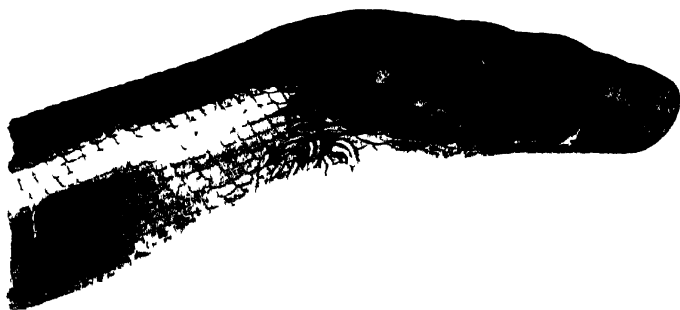


FIG. 31. HEAD OF SEA SNAKE FROM THE GULF OF CALIFORNIA.
 Showing split fin. Fin isles growing in the split.



FIG. 32. EGG CASE OF A DEEP SEA RAY AND THE NEARLY HATCHED EMBRYO
 IT CONTAINED

Found in the bottom nearly a mile down at Station 74

through the water glass. Two sharks were swimming slowly about the very rock where I had been sitting a few minutes before, probably the same individuals who had then been so curious about me. A small group of the pigfish swam around, over and below the sharks, as they had also done when I was submerged, sometimes passing within a foot of the sharks' mouths without the slightest show of emotion, of fear or otherwise. An angel-fish and two yellow-tailed cows passed, and a golden grouper together with two deep green giants of the same species, milled around beneath the boat, cocking their eyes up at us, now and then.

I baited the hook with a toothsome bit of crab and lowered it. All the pigfish rushed it at once, and as it descended, the sharks and groupers followed with mild interest, almost brushing against it, but wary of the line. Failing to elicit any more practical attention from the golden grouper I allowed one of the pigfish to take the bait and hook. Then, watching very carefully, I checked his downward rush, and swung him upward. He struggled fiercely and like an electric shock every shark and grouper turned toward him. Without being able to itemize any definite series of altered swimming actions, something radical had happened. The remainder of the school of pigfish, while they remained in the neighborhood, yet gathered together in a group and milled slowly in a small circle. There was no question that from being a quiet, slowly swimming, casually interested lot of fish, the three groups—pigfish, groupers and sharks—had become sur-

charged with interest focussed on the fish in trouble. I drew the hooked fish close to the boat, and could plainly see that the hook had passed only around the horny maxillary. There was not a drop of blood in the water, and the disability of the fish consisted only in its attachment to the line. Yet the very instant the struggle to free itself began, the groupers and sharks, from being at least in appearance friendly, or certainly wholly disregarding the pigfish, became concertedly inimical, focussed upon it with the most hostile feeling of an enemy and its prey.

For half an hour I played upon this reaction and learned more than I had ever seen or read of the attacking and feeding habits of groupers and sharks. When the struggling began the sharks all turned toward the hooked fish. Not only the one nearest who must easily have seen it for himself, but two, far off, turned at the same instant, and within a few seconds two more from quite invisible distances and different directions. What I saw seemed to prove conclusively that sharks, like vultures, watch one another and know at once when prey has been sighted by one of their fellows. The numerous sharks thus call one another all unintentionally, as when one of our party caught a shark at Cocos, and in an incredibly short time there were seventeen attacking it. On the other hand it must be admitted that sharks differ from vultures as widely as the poles in the matter of scent. Vultures all but lack this sense, while we know that fish have it well developed. But even in the case

of blood in the water, it seems to me that diffusion cannot be nearly rapid enough to account for the instantaneous reaction on sharks near and far. The phenomenon is as remarkable in general aspect as the apparent materialization from the air of a host of vultures where a few minutes before none were visible.

Even more than in this problem, I was interested in the exact method of feeding of sharks and groupers. After making sure of the first phase of interest, I allowed a six-foot shark to approach the hooked pigfish. It came rather slowly, then with increased speed and finally made an ineffectual snap at the fish. The third time it seized it by the tail and with a strong sideways twist of the whole body, tore the piece off. The second fish attacked was pulled off the hook, and two sharks then made a simultaneous rush at it. So awkward were they that one caught his jaw in the other's teeth and for a moment both swished about in a vortex of foam at the side of the boat.

I noted carefully about thirty distinct efforts or attacks on the hooked fish, and only three times was I able by manœuvering the fish to get the shark to turn even sideways, never once on its back as the books so glibly relate. I sacrificed seven pigfish, and then tried to get the golden grouper but it was too wary. A giant five-foot green grouper, larger than any we had taken thus far, was becoming more and more excited however, and when I had tolled him close to the surface I let my fish lure drift loosely. One swift snap and the entire fish

disappeared, then a single slight nod of the head and the line parted cleanly. The general effect was of much greater force and power exerted in a short space of time than in the case of the sharks. When it comes to lasting power for only a short time, after being landed, however, the groupers fight while the sharks smash and thrash until they are actually cut to pieces.

After this exhibition, without hesitation, I dived in the helmet again in this very spot with no change in the attitude of the sharks toward me. I had had these sharks close to me a little while before, and although my efforts under water seem to me no less awkward and helpless than a hooked pigfish, yet to these so-called man-eaters, there is apparently all the difference in the world, and I was absolutely safe from attack.

Mr. Zane Grey, who, at my recommendation, went to Cocos and the Galápagos, had as his object big-game fishing, and as the following paragraphs will show, he underwent the same experience that we had, both when we were here two years ago on the *Noma*, and now again on the *Arcturus*.

Fishing off Chatham Bay, Cocos Island, he writes in his book "Tales of Fishing Virgin Seas,"—"The next hour was so full of fish that I could never tell actually what did happen. We had hold of some big crevalle, and at least one enormous yellow-tail, perhaps seventy-five pounds. But the instant we hooked one, great swift gray and yellow-green shadows appeared out of obscurity. We never got a fish near the boat. Such angling got on my

nerves. It was a marvellous sight to peer down into that exquisitely clear water and see fish as thickly laid as fence pickets, and the deeper down the larger they showed. All kinds of fish lived together down there. We saw yellow-tail and amber-jack swim among the sharks as if they were all friendly. But the instant we hooked a poor luckless fish he was set upon by these voracious monsters and devoured. They fought like wolves. Whenever the blood of a fish discolored the water these sharks seemed to grow frantic. They appeared on all sides, as if by magic.

"By and by we had sharks of all sizes swimming round under our boat. One appeared to be about twelve feet long or more, and big as a barrel. There were only two kinds, the yellow sharp-nosed species, and the bronze shark with black fins, silver-edged. He was almost as grand as a swordfish.

"While trying to get the big fellow to take a bait I hooked and whipped three of this bunch, the largest one being about two hundred and fifty pounds. It did not take me long to whip them, once I got a hook into their hideous jaws. The largest, however, did not get to my bait.

"An interesting and gruesome sight was presented when Bob, after dismembering one I had caught, tumbled the bloody carcass back into the water. It sank. A cloud of blood spread like smoke. Then I watched a performance that beggared description. Sharks came thick upon the scene from everywhere. Some far down seemed as long as our boat. They massed around the carcass

of their slain comrade, and a terrible battle ensued. Such swift action, such ferocity, such unparalleled instinct to kill and eat! But this was a tropic sea, with water at eighty-five degrees, where life is so intensely developed. Slowly that yellow, flashing, churning mass of sharks faded into the green depths."

Again Zane Grey writes from Darwin Bay, Tower Island, after hooking a huge shark: "Then the fun began. It really was not fun, but work under a hot sun, in a bobbing boat, with thundering surf always threateningly near at hand, and most unforgettable of all, with a school of huge black sharks following the one I had on. When I got the double line over the reel I kept it there, and as a consequence had the shark in sight all the time. His comrades glided between him and me, bumped the boat with their tails, and acted in every way to convince a reasonable angler of their dangerous mood. They were undoubtedly man-eating sharks. If R. C. had not been in sight and within call I never would have risked my life in that cockleshell of a launch, amidst a swarm of ravenous wolves of the sea. At length this one, like the other two, broke my leader, demonstrating fully that this especial kind of copper wire was useless for fishing."

Now Mr. Grey is probably the foremost big-game fisherman of the world, and knows more of the habits of these fish from the sportsman's angle than any of his fellow human beings. Under the circumstances that he describes, few men, certainly

PARTI-COLORED BUMPHEADS
Bodianus eclancheri (VALENCIENNES)

(Average length fifteen inches)



not I for one, would have dared to think otherwise than he did of the sharks of Darwin Bay. And yet, after all, their man-eating, dangerous qualities were circumstantial, and engendered by what he observed in their attacks on hooked fish, of their own or other species.

Less than a month after he left this wonderful bay, the *Arcturus* anchored in it, and a few days thereafter Dr. Gregory, Ruth Rose, myself and all the rest of my staff were diving in helmets, and walking about the bottom, with these self-same "man-eating" sharks swimming by and around and over us, dashing at and taking our hooked fish, but, except for a mild curiosity, paying no attention to ourselves. It was as unexpected to me as to anyone, yet I will go on record as saying that it is perfectly safe to sit or walk around, or climb up and down ladders and ropes, to leap or twist quickly about, or to sit motionless, protected only by a copper helmet and a bathing suit, among the sharks of Cocos and the Galápagos, whether they are swimming slowly along, or devouring some fish, dead or in obvious trouble.

CHAPTER VIII

FLOTSAM AND JETSAM

IF heat is the mother of all life then water is surely its father. We came from the water, we are still absolutely dependent upon it, two-thirds of our entire body is nothing but water. In our physical frame we carry with us many aquatic memories, water-logged characters which point to distant amphibious or submarine ancestors. The mark of the sea is upon us though our home may be in the heart of a continent.

The simplest of beings are inhabitants of water—mere droplets of movement, hesitant on the threshold of life, as yet neither quite plants nor animals. In comparison, a forming crystal may seem a great advance, a restless oil globule suggests a sentient organism. But the droplet of life can afford to rest motionless. It treasures in its minute nucleus a something possessed by neither crystal nor globule.

It would almost seem as if water, especially sea water, had some slumbering force within itself, a dormant sympathy for organic life which needed merely the slightest stimulus to awaken and to take its share in dynamic animation. A suspended cobweb vivifying the air about it into complex ac-

tivities would be no more of a marvel than the jellyfish which moves through the sea and is itself the very essence of water. Dry it, and there remain neither bone nor tendons, disturbed organs nor traces of blood, but only the faintest of glistening films, which disintegrates and blows away with the first breath of air. Yet imbued with its ninety and nine parts of salt water, it moves and contracts and throws its poisoned darts, it swallows and digests, and dimly sees and feels, it produces eggs and strews them like chaff as it slowly vibrates on its course. Yet so evanescent is it that it seems like some organic mirage. The eye often misses it altogether, looking straight on and through its being, and finally locating it by its shadow. The earth-wide basins of liquid gently sustain and capably support the host of beings who experience life and death among the waves. In countless ways each tiny creature is ministered to, and given his chance to fight upward toward the unknown caste-to-come which seems the sole object of the existing of these lives.

Important as water is to all higher creatures, its actual astounding percentage in tissues and organs is more and more completely concealed from view. But always we perceive new, unexpected qualities. And when unusual demands are made they too are granted. Creeping upon the mud and coral are myriads of shellfish whose flesh would tempt every passing fish. So when their need cries aloud for protection, the Father of Life comes to their aid. By some strange, secret alchemy they draw from the

transparent water the hardest and most durable of walls, and encase themselves in shells of lime, of marvellous architecture and splendor of pattern and pigment.

In the course of past time, fishes of the sea covered themselves with scales of shining silver and developed four important fins—prophecies of wonderful legs and arms and feet and hands, if one could only have known. But in those times the Great Father of Waters was in no fear about the desertion of his children. Fishes leaped from the waves and even learned to skim through the air on outstretched fins. But they always plopped back exhausted. And when other creatures insisted on clambering out on mud-banks and flipping themselves along, the great breakers merely chased them and good-naturedly rolled and tumbled them back again into the green frothy water. And the ocean in those days swept round and partly over the half dried land, and the sound of the storm waves vibrated uselessly around the headlands and through the valleys, for there were no ears to hear.

By the time the first little monkey climbed down a swaying vine for his evening's drink, the domination of the sea had become lost in the past. The earth was galloped over and burrowed into by myriads of beings; trees were perched on and bored through; the air hummed and whistled with wings and webs and leaping forms. So completely a thing of the past had the sea life become that many creatures had gone back to it as to quite a

new element. Their old, old aquatic memories helped them not at all, and the penguins had to re-stiffen their feathers into scales, and to encase their wings in immobile mittens cut after the fashion of sharks' fins. And the seals ceased the running about upon the land and became completely readapted to a sea life.

So let us return, at least mentally, to the Sea, for there is no happening on land which cannot there be duplicated and often bettered. But to appreciate these similarities to the full, one must become amphibious. As well live in Kansas or Switzerland and know the ocean only in the encyclopedia volume **MUN** to **ODE**, as sit in a deck chair and watch it pass or scan its waves with binoculars. To such a watcher no real secret is ever confided—he thinks in terms of waves and swells, and his eye is held by the horizon beyond which is the dry earth for which he longs. But to the aquatic devotee, the oceanic fan, surprise after surprise is vouchsafed, for to him the three elements are not phenomena wholly apart.

We are grateful to the dry land for standing room, to the air for the breath of life. But any glance askance at the watery depths is but a pitiful or a comic gesture when we remember that 85% of our brain is water, and much more akin to salt than to fresh. To be sure we cannot drink salt water and live, but when necessary it is an admirable temporary substitute for blood itself, whereas sweet water would be a fair poison in our veins. Take the man who shudders at the thought

of the ocean's depths, and put him in the midst of a tropical desert at breathless noon, or make him climb the Himalayan hills until his very marrow is frosted with the winds which caress Kinchinjunga, and his lungs cry out for their need of oxygen,—and his natal earth will seem quite as inimical as the great waves of mid-ocean or the black liquid depths.

For countless voyages I have hung over the bow of passenger steamers in mid-ocean, making of myself a figurehead of sorts, straining my eyes downward to watch the living creatures which whirled into sight and swept past. Dolphins, flyingfish, tunny, an occasional shark—these are familiar to all who have ever glanced over the bow. But the rays of the slanting sun striking obliquely into the smooth surface often revealed a myriad, myriad motes—more like aquatic dust than individual organisms, which filled the water from the very surface to as deep as the eye could penetrate.

Toward sunset these would vanish in the increasing dimness, and finally the bow would cut its way through an opaque, oxidized liquid, as unlike water as tar to glass. The moon overhead which showed in the waning day as a crescent of cloud, now cuts through the darkness like a sliver of gold. So the minute sea life becomes, in the dark, redoubly visible, and the ship ploughs a deep furrow through miles of star dust—phosphorescence which will fill the last imaginative human being as full of wonder and awe as it did the first who ever ventured out to sea.

As I have elsewhere explained, the floating oceanic life is known as plankton—indicating the helplessness of these wanderers, drifting about at the direction of the winds and currents. Even vaguely to estimate the abundance or numbers of these powdery clouds of animals of the ocean is to attempt a Herculean task, second only to numbering the sands of the shore or the proverbial hairs of our head. One dark, moonless evening I put out a silk surface net the mouth of which was round, and about a metre or a yard in diameter. At the farther end of the net a quart preserve jar was tied to receive and hold any small creatures which might be caught as the net was drawn slowly along the surface of the water. This was done at the speed of two knots and kept up for the duration of one hour. When drawn in, the net sagged heavily and we poured out an overflowing mass of rich pink jelly into a white flat tray. This I weighed carefully and then took, as exactly as possible, a one-hundred-and-fiftieth portion. I began to go over this but soon became discouraged, and again divided it and set to work on one sixth of the fraction on which I had first started. After many hours of eye-straining and counting under the microscope, I conservatively estimated my $1/150$ part of the hour's plankton haul as follows:

Feathery copepods—Candace-like	7,920
Bright blue copepods—Pontella-like	71,400
Other copepods—Calanus-like, pink	139,320

200 THE *ARCTURUS* ADVENTURE

Bivalve crustacea—Ostracod-like	4,920
Short-eyed shrimps	720
Siphonophores	14,400
Helix snails	8,880
Purple <i>Ianthina</i> snails	13,440
Egg masses of snails	1,080
Free eggs, various	5,280
Arrow-like flying snails (<i>Clio.</i>)	2,520
Nautilus-like flying snails (<i>Limacina?</i>)	240
Oyster-like flying snails (<i>Carolinia?</i>)	960
	<hr/> 271,080

If we multiply this by one hundred and fifty we get forty million, six hundred and sixty-two thousand individuals. Please remember that this is a very conservative estimate of only a few of the more easily counted groups in one small haul of an hour's duration, and the magnitude of the life of the sea will begin to dawn upon our minds. Twelve hours later—in full daylight—I repeated the haul as closely as possible and, instead of forty million, I captured about one thousand individuals of the corresponding groups. So although plankton is an involuntary horizontal wanderer, yet vertically it has more perfect control, and having developed its own system of lighting it will have nothing of the sun or even of moonlight, and remains well below reach of the stronger rays.

My own interest in plankton is wholly that of trying to disentangle the lives of some of the small people—to put myself in their places by day and night, but I feel that I must establish their im-

portance in the minds of more practical and far-seeing readers. Realize then, that even for our human race, the universe of plankton is of vital importance. The surface-loving copepods are commonly and correctly known as "whale food," and they are also the most important food of many fishes. Only at the surface can vegetable life exist and develop, changing sunlight into edible materials, and in plankton diatoms and other plants affording satisfactory aquatic fodder to the small grazing animals about them. They thus start the ball of life rolling, which does not cease until it includes the possibility of continued existence for whales and food fishes, while, in the future, the whole human race may come to depend upon this larder of ocean.

Indeed it is a remarkable fact that ship-wrecked men in an open boat, if their lot is cast on waters rich in plankton, need never starve to death if they can manage to drag an old shirt, net fashion, through the water at night. The great percentage of crustaceans makes plankton a rich, nourishing food, even raw.

I can imagine no swifter way of killing anyone's interest in plankton than to put him in front of a pan of forty million swarming small folk. We have only a sort of hypnotic or at most superficial interest in a regiment or mob; and so I gave but the merest mechanical attention to the thirteen thousand odd *Ianthina* snails in my counting tray. But when I lay flat on my pulpit platform and began scooping up, one by one, the

creatures which for years I had watched go past out of reach, then my distant longings began to change into intimate acquaintanceships, and I learned to admire and to have a real affection for these little fellow beings who lived their lives with me on this whirling planet.

Hummingbirds vibrate before flowers, albatrosses skim for hour after hour over the waves, but sooner or later every bird must come to rest—its muscles exhausted, its wings aweary. But for the mid-ocean folk there is no rest as we know it. Somehow or other they must keep themselves suspended. A list of possible ways, thinking as always from our own experience, would include swimming or flying, treading water, balloons of air or gas, or clinging to some bit of floating wreckage, whether from a storm-broken ship, a bit of porous lava, or a pinion dropped by a passing seabird. All these and many others are actually in use, and had been so for millions of years before man had brain enough to make a list.

Oblong pieces of whitish scum had tantalized me for many voyages, and even when I had emptied one of these bits from my net into a small aquarium I could make nothing of the mass of bubbles, until I looked beneath the surface and there saw that exquisite violet sea-shell with the euphonious name of *Ianthina*. Although this snail lives in a home of tissue-thin lime, it yet spends its entire life at the surface of the ocean. Its relations which we know on land leave a trail of glairy slime wherever they walk, and *Ianthina*

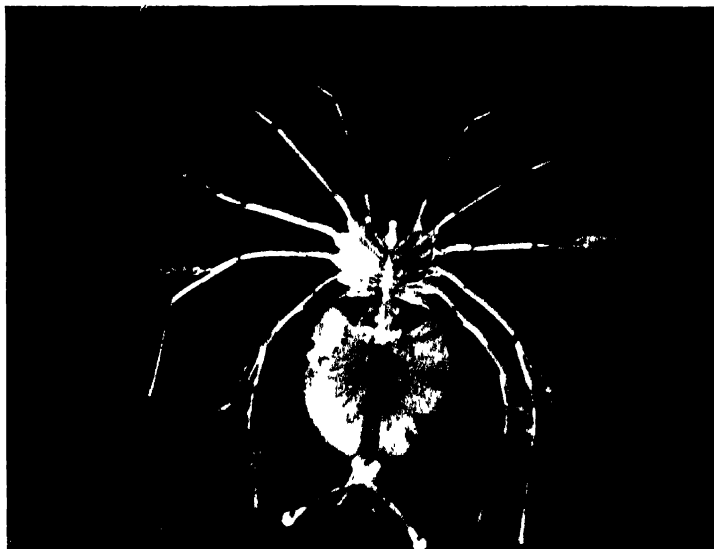


FIG. 33.—PHYLLOSOMA—A TRANSPARENT, LARVAL CRUSTACEAN.

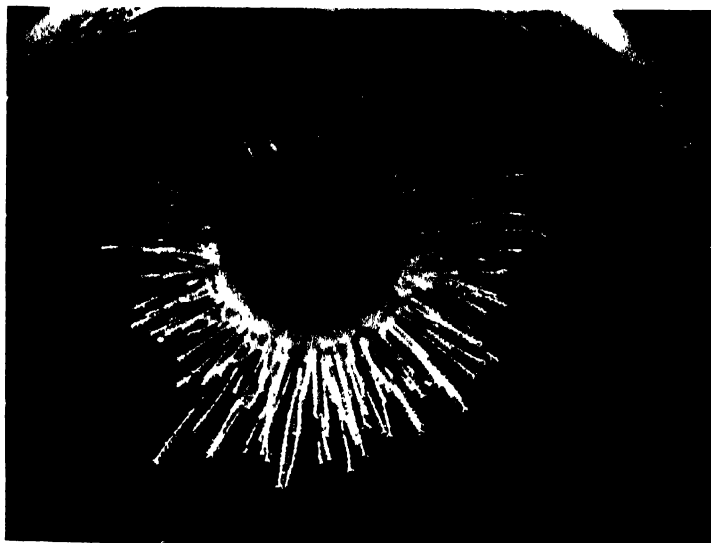


FIG. 34 — *Porpita*, ONE OF THE MOST BEAUTIFUL OF THE FLOATING JELLY-FISH.



FIG. 5. GIANT RAY OR DEVILFISH SWIMMING AT THE SURFACE

This was taken on October 11 measured 61½ inches feet from tip of the wing-like fins

still has the gland which secretes this, but has etherealized its use. The thin secretion is poured forth, and then, by successive upreachings of a part of the foot, bubbles of air are caught and entangled in the slime, which soon extends out as a narrow buoyant raft, the shell hanging down at one end. The bubble slime is not only balloon but nursery, and egg after egg is suspended from the lower surface. So abundant were these snails that I observed them with only general interest, thinking of course that their whole life history was well known, but on my return I found that this was far from the case, and that few facts are known about them.

There are two kinds of thrills in science; one is the result of long, patient, intellectual study. An example of this is the years of astronomical calculation whereby movements of certain heavenly bodies can be explained only by the existence of some unknown factor, and then one day this unknown but expected star is found at the very spot indicated by mathematical necessity.

Another thrill lies in an absolutely unexpected discovery. Night after night small white spots floated about on the water just beyond the glare of the gangway electric lights. In vain we tried to net them. Now and then several would join together in a sinuous row and swim slowly along. At last, with an effort which almost precipitated him into the sea, Serge Chetyrkin scooped one up and dropped it into a small jar. To my astonishment I saw it was an argonaut or nautilus—a

paper nautilus—which, in other words, is a diminutive octopus with the most exquisite shell in the world. Never have I seen a creature with a more explosive temper—we named her Mrs. Bang on the spot. Hardly had I changed her to a small aquarium when she angrily shot forth a cloud of sepia, and had to be transferred twice before her ink-bag was emptied and I could observe her clearly.

She rested quietly on the bottom with her many arms wrapped about her beautiful brown and white shell. But as soon as my face approached the glass, she rushed back and forth, shooting directly at me or bumping against the opposite glass, and finally backing into a corner. Here she spitefully squirted spouts of water through her siphon, until I gave her a small fish. She snatched it ungraciously, bit its head off and ate the body, feeling suspiciously about with three or four arms in my direction the while (Fig. 15).

Two days later she went into such a paroxysm of rage that she flung herself clear out of her shell. I carefully picked this up and found her eggs still remaining inside. There were thirteen hundred of them, even-ended ovals, about ten by fifteen millimeters, with a tiny thread at one end which attached them loosely together, exactly like a miniature bunch of grapes—the smaller stems growing out from larger and these in turn from a twisted, central rope. The embryos were in various, well-advanced stages, with the future eyes of the infant argonauts marked by two large, red spots.

The shell of the argonaut is secreted by two

great flat plates on the arms, and it was formerly thought that when, in calm weather, the owner rose to the surface, it sat back comfortably in its shell, raised the two broad arms aloft and used them as sails. Such a performance should properly take place only within sight of the fleets of entangled ships in the Sargasso Sea!

I never tired of watching the squids and octopuses which we captured. Soon after we landed the nautilus, Serge, with his usual skill, caught a two-foot squid which I studied for many minutes. It squirted sepia all over us and bit our hands before we could drop it in an aquarium. When it quieted down it pulsated slowly, while the colors came and went over the body in such a way that new adjectives will have to be coined adequately to describe it,—reds, blacks, browns, yellows, rolling, surging, springing into vision as the pigment spots contracted or expanded, a living, liquid palette.

The staring eyes were oval, and of an astonishing turquoise blue, and even on this surface, scarlet spots grew and passed—vanishing completely, only to reappear and coalesce so that the turquoise became carnelian. I looked into the sinister, narrow, cat-like pupils, and they seemed to express all the horrible mystery of things which should not be,—such as these monstrous, flabby creatures calling the snail, the slug, the nautilus and the oyster brothers—possessing not even the prestige of having fallen, like the humble sea-squirts, from higher aspirations—shellfish they are and nothing

else. And yet unreasonably possessing an eye, as well as or better developed than our own. When to a low evolved mollusk thing, there has been given a "window of the soul" such as this, one wonders what secret, what thing of enormous value must have been bartered for it, what sinister transaction at some nefarious "Bureau d'Echange de Maux." A hand even, would not have been so unexpected, nor a foot patterned after those of infinitely higher beings, but such an eye should not be in such a body.

Before we lose ourselves among the small folk of mid-ocean let us strike a contrast. Day after day, from the crow's nest or the bridge we caught sight of the monsters of the ocean's surface,—occasional sunfish so gigantic that, so long as they remained out of reach of a yard-stick, it were better for a scientist to call them merely exceedingly large. A layman might use the simile of a vertical barn-door and not exceed the truth. Indeed the same time-worn phrase if considered horizontally would be less than the actual fact if applied to some of the devilfish or giant rays which we saw. Now and then a playful one would leap almost out of the water, or pass close to the bow on its graceful, leisurely aquatic flight (Fig. 35).

North of Narborough they were so numerous that three of the staff, Dickerman, Franklin and Cady, made up their minds to capture one.^c Assembling every weapon, legitimate and otherwise, which the *Arcturus* afforded, they set out in a tiny row-boat and made good. When, later on, we ana-

lyzed the fight from the motion pictures, we realized that luck had surely been with us, for if the great fish had slapped its wing tips a little nearer and higher, the rowboat and devilfishers would have been flattened. When once a harpoon was deeply fastened to the fish, the battle became merely a question of trying to tire it out, and to hope that the injury inflicted by the hail of bullets would antedate the effect of their accumulating weight!

Something at last was effective and after two hours the devilfish surrendered and was towed to the *Arcturus*. Several lashings were broken before it was at last drawn out of the water and lowered on the deck (Fig. 30). Here was a specimen indeed, not to be placed on the stage of the microscope, but studied by walking around, over and almost into, for its gaping mouth was quite four feet wide. From fin tip to fin tip it measured exactly eighteen feet, and little by little as we cut it up we weighed the pieces and found it to total two thousand, three hundred and ten pounds. The liver alone weighed as much as a man, and we found a young devilfish about to be born,—a lusty infant weighing twenty-eight pounds and with a fin spread of over three and a half feet. As usual the fish had many interesting parasites. I took eight sucking fish from its gills and at least thirty more fell off when it left the water. On the skin were many weird-looking parasitic crustaceans.

These great fish are not especially wary and a few days before when returning from a diving ex-

cursion near shore we played with one for an hour, bumping into it continually with our bow and being splashed by the threshing fin-tips as it half turned over. There were two close together, each with a ten foot expanse of wings. They refused to leave or to go down although we pummeled them with the oars, and they were still swimming and rolling about when we left.

Merely to enumerate the species of floating, living beings which we took in our surface nets would fill this chapter, so all we can do is to think for a moment of the most characteristic ones. If a cupful of pond water is examined, tiny creatures will be seen shooting about, and under the lens one of these resolves into a crustacean thing, with two enormously long horns or antennæ, and a single, median eye. This is aptly named *Cyclops*, and is a member of the group of copepods. We may recall that these little beasts comprised thirty million of our enumerated plankton haul, and so abundant are they that they usually give the characteristic color to the hauls or even to the ocean for miles around, varying from carnelian red to deep madder blue.

Oceanic crustaceans in general and copepods in particular correspond in numbers and variety to the insects among terrestrial creatures. Indeed as regards beauty and variety I can compare copepods only with snow crystals. Very small species often contained good-sized oil globules which seemed to serve the purpose of buoyancy, but these were lacking in larger, 'bizarre forms who

relied on the most amazing development of appendages, some having widespread, feathery tails affording a great expanse of surface for support in this thin medium.

In the dark a small dish of this plankton would glow like a trayful of diamonds, but in the light no trace of luminescence could be detected. And yet, now and then, even under the binoculars there would come a flash as of fire opal. Little by little I narrowed this down until I had in the field of vision a single oval copepod, about an eighth of an inch long. When viewed from the side it showed as a mere tissuey line, but when it turned on its back every color of the spectrum was kindled. *Sapphirina* is its name, but *Opalina* would be more appropriate.

Traces of Aquarius or Pisces might reasonably be expected in these submarine regions, but hardly of Sagittarius, and yet hardly any pipette of plankton would fail to show numerous little arrows shooting across the field of vision. These are worms in structure if not in conventional outline, but their name *Sagitta* makes up in aptness what they lack in vermiformity. They are transparent, slender and quite stiff, with well-marked fins. The entire anterior end is composed of a mouth armed with great teeth-like bristles, indicating a type of life and diet far different from that of the quiet, plant-eating copepods.

Many of the day-time animals which called the surface of the ocean home, were ultramarine above and silvery white beneath, stained thus with the

very essence of their surroundings,—a vital factor in helping to hide them from the eye of enemies which looked down upon them from the air, or upward from the depths. But at night a host of small creatures found safety in being divested of all pigment. In the course of evolution they had scraped off all the mercury from the back of their beings, becoming so transparent that the food which they swallowed was the most conspicuous and opaque part of their anatomy.

I could never quite escape from a decided Alice in Wonderland feeling when I looked into a dish of night plankton scooped from the surface. By keenest scrutiny I could perceive only the usual hosts of small fry, when, reaching down and lifting out what seemed only an area of clear water, there would materialize before my eyes a *Phyllosoma* (Fig. 33). This was a creature who cast no more shadow than the thinnest skim of clear ice. Yet it was a living animal, more than three inches long, with all the general organs which we ourselves possess,—eyes, mouth, feet, stomach, nerves, muscles and a strong will to live. *Phyllosoma*, or leaf person, was the only name I could give them, although glass crab would be more appropriate, for they were the young of some lobster-like crustacean and nothing is known of the intermediate stages.

On land the barriers which confront animals are very apparent and tangible—mountains, deep valleys, rivers, lakes, the presence or absence of treeless plains, etc. At sea, living creatures are

confined with almost equal rigidity by invisible walls. Temperature, salinity, pressure and light are some of the intangible and impassable frontiers. But the study of these requires a maximum of diagrams and schedules which would be out of place in this volume. Nevertheless, there is drama and tragedy, plot and adventure, so let us consider sunlight and darkness, or even light and shadow. I have already told how the beings who love the surface of the sea at night are all but absent from it in the daylight, but many others are willing to come up if they can find the merest excuse or parody of a sheltering shadow.

I will work up to concrete examples by a few minutes' observation from the pulpit, which always revealed the life and death need for even the slightest protection. The most faithful attendants of the *Arcturus* were the tunny fish, who kept close to the bow hour after hour, yielding to the occasional dolphins but returning at once when they had gone. Looking down through the ultramarine film I saw a score of these fish metamorphosed to rainbow colors—rich violet bodies with yellow finlets and black tails. Now and then an unfortunate flyingfish rose, then a tunny turned aside, there was a flash in the air of molten silver and the tunny was back. A few minutes later a dense mob of several thousand half-beaks rose like hail. These fish are on their way to becoming flyingfish, and, sculling frantically with tail fins, skim through the air, like planes near the end of their taxiing run. Every tunny within sight flung itself headlong into

the boiling mass, took toll, and returned to the pace-making bow race.

Ten minutes more passed and a *Pyrosoma* drifted by—a great, pink, hollow, cylindrical colony of unfortunates who had just missed being vertebrates like the tunny and ourselves. Beneath this cylinder of jelly was a half-dozen pilot fish. For some reason—and this is the crux of the whole matter—so long as they crowded beneath it, no tunny paid any attention to them, although so far as actual concealment went, they might just as well have been hiding beneath mosquito netting or a Greek peristyle. As our bow approached their living roof they became panic stricken. All six little fish dashed out, and as if moved by the same mechanism, six tunnies gave six snaps in the very foam of the bow wave, and six little pilot fish were relieved from further worry about their destiny. It cannot be that the tunny fish do not see their ambushed prey, but as a cat will often wait until a mouse makes some movement before it springs, so there may be some instinctive, hair-trigger, piscine law, of vital moment to them, but which in our own case we would similize with the sporting chance of a wing shot.

I came to have the feeling that far down beyond where my eyes could penetrate were uncounted hosts of little eyes peering upward, waiting for the revealing sunlight to lessen, as animals and flowers appear along the edge of retreating snow, following it, occupying every bare piece of ground. The cook would throw over an empty tin can, and

if it failed to sink there would soon be a small fish swimming close beneath it. I could imagine the slender cone of shadow which the can cast downward and the fish, feeling its comfortable darkness, followed it up until it focussed on the bobbing bit of floating tin.

In calm sunny weather as the *Arcturus* steamed along at full speed, few or no fish were to be seen in the open water. Then "full stop" would clang when I decided to sound or take temperatures and soon after we began to float quietly, on the shady side, fish, small crabs and other creatures would begin to collect, coming up from deeper levels into this premature twilight. These, however, were only the skirmishers on the edge of the great nocturnal host—that vast army who could never be fooled by an artificial night and who kept far down below the twilight zone, waiting for the blotting out of the sun before they began their upward rush. I had read of this interesting vertical migration before I started on the *Arcturus* and the contents of every net proved its magnitude. But not until I inaugurated a series of twenty-four-hour surface hauls, taken at fifteen minute or half hour intervals, did I appreciate the clock-like regularity of the movement. After a little practice, I knew that if I wanted a certain type of nocturnal surface fish, a haul at 4.15 to 4.30 A. M. would invariably capture some, while the net drawn from 4.45 to 5 o'clock would never contain a single one.

At Station Seventy-four, I made twenty-four hauls in as many successive hours and took over

four hundred fish of twenty-six species. Up to 6.30 in the evening all the more abundant surface fish of the daytime were captured, such as pilot fish, half-beaks, flyingfish and young *Seriolas*. After this, not one was ever seen, but promptly at 7 o'clock six species of lantern fish, *Myctophid*, appeared, and a half hour later their enemies, such as *Astronesthes*, were taken. In early morning the reverse occurred, and only one species of lantern fish ever lingered after 4.30 A. M. up to which time they were taken in dozens (Plate V).

In the case of most oceanic organisms we cannot tell by a casual examination whether they are diurnal or nocturnal, but even if we had never seen a living lantern fish, their equipment of lights, like that of fireflies, could mean nothing but a life spent in darkness. This luminescence in sea creatures has always held a great fascination for me, and when first I saw among a mass of plankton several of these fish, it was a memorable event,—like my first electric eel, or my last glimpse of the Himalayas. My interest in the subject was whetted when I had translated a recent résumé of the subject and found that nothing but casual and fragmentary observations on living luminescent fish had been made, and these mostly by fishermen.

Several times I rushed to the photographic dark-room with a dead or dying specimen, to see nothing but the gleam from the numerals of my wrist watch. Then one evening I filled a small aquarium with cool sea water and placed in it three newly caught *Myctophids*. Suddenly one of them flashed

LUMINOUS SURFACE FISH IN DAYLIGHT AND DARKNESS

An Eater-of-stars (*Astronesthes*) in pursuit of two
Lantern-fish (*Myctophids*)

Fig. A The fish in daylight

“ B. The fish in darkness showing various types of
luminescence.



FIG. B

out so brilliantly that the glass dish, our hands and our faces were clearly outlined. Lin Segal and I spent many evenings in this research and recorded a great number of separate interesting facts, which, like all pioneer work, must be presented in their place without connection or correlation. Out of the mass, however, there are certain ones which fall into orderly relationship, and give a faint but tremendously suggestive hint of the life which these fish lead in the darkness of their underwater world.

I shall consider only the slender-tailed lantern fish (*Myctophum coccoi*) which I took in numbers both in the Atlantic and the Pacific. Imagine a minnow (Colored Plate V), which is iridescent copper above and silvery white below, not over two inches in length, with large eyes and moderate fins. A full-grown fish weighed a gram, which means that it would take about four hundred and fifty to make a pound. It feeds on copepods, sagittæ and other minute plankton fry, and from this food it generates energy to live, to fight, to migrate up and down, to keep illumined one hundred lights and to lay upwards of seventeen hundred eggs.

Scattered over the body are many small, round, luminous organs, which we may divide into three general sets. First, thirty-two ventral lights on each side of the body, extending from the tip of the lower jaw to the base of the tail; second, twelve lateral lights arranged irregularly along the head and body, and third, a series of four to eight

median light scales, either above or below the base of the tail.

From the very first I directed all my attention to the possible utility of these lights. The lower battery, when going full, cast a solid sheet of light downward, so strong that the individual organs could not be detected. Five separate times when I got fish quiet and wanted to a large aquarium, I saw good-sized copepods and other creatures come within range of the ventral light, then turn and swim close to the fish, whereupon the fish twisted around and seized several of the small beings. Once it turned completely on its back. I could never have seen this except that the glass sides of the aquarium reflected sufficient light. Whether this is the chief object of the ventral lighting I do not know, but it is at least occasionally effective.

Perhaps the best distinction between various species of this group of lantern fish is the arrangement of the lateral light spots,—indeed in the dark-room I could tell at a glance how many species were represented in my catch by their luminous hieroglyphics. When several fish were swimming about, these side port-holes were almost always alight, and thus it seems reasonable to suppose that they are recognition signs, enabling members of a school to keep together, and to show stray individuals the way to safety.

The light scales of the tail are apparently of great importance. Ordinarily when the whole fish is glowing with the pale, cold, greenish light of luminescence, these caudal lights are seldom seen.

A clue to their use is to be found in the fact that they show a remarkable sexual difference, the males having them on the upper side of the tail base, and the females on the lower side.. Of course in my necessarily brief and sporadic researches, when no fish lived longer than thirty-six hours, there was no chance to observe courtship or any such use which these lights might subserve. But when a fish exerted itself unduly to get out of the way of another, either of its own or another species, these lights would flash and die in quick succession. Three separate times in unusually strong, vigorous fish when the body luminescence was very dim, these scale search-lights flashed like heliographs, being much stronger than the combined, steadier glow of all the others. This luminescence was of a much deeper green than that of the ventral lights. If continuously alight, a single fish would enable one easily to read fine print.

In the dark it was thus possible to distinguish species of lantern fish by the lateral hieroglyphic heliographs and the sexes by the upward or downward direction of the tail lights. I have never seen the latter illumination given out by a fish swimming alone in an aquarium. Although it is very evident that the caudal flashes have some sexual significance yet another very important function seems that of obliteration. It certainly was to my eyes, and I have no reason to think that a natatory enemy might not also be frustrated. When the ventral lights die out they do so gradually, so that the eye holds the image of the fish for a time after

their disappearance, but the eye is so blinded by the sudden flare of the tail lights that when they are as instantly quenched, there follow several seconds when our retina can make no use of the faint diffused light remaining, but becomes quite blinded. A better method of defence and escape would be difficult to imagine. Although I sometimes captured twelve hundred lantern fish in a single hour's surface haul, the wonder of this animal illumination never became less marvellous.

An hour or two after the first Myctophids had come to the surface, I would occasionally find a somewhat larger, black fish among them. In the glare of the laboratory electric lights this was not a very unusual-appearing fish, although it had a short, dependent chin tentacle and a mouth with exceedingly wide gape. It was a fish named *Astronesthes* (Col. Plate V), and for once the ichthyological Adam had showed imagination, for these Greek words mean "An eater of stars." Not until I dissected one did I realize the full significance of this title, for in each *Astronesthes* I found a full-sized, just-swallowed lantern fish, although the former was only about one-third longer than its prey. In the dark, this voracious black fellow was a gorgeous sight, the skin covered with a host of minute luminous specks, while the fins fairly glowed with pale green light. Curiously enough, it was the stem, not the specialized tip of the chin tentacle, which was luminescent.

But I have given more than enough space to such plain unvarnished facts concerning these com-

mon fish of the nocturnal ocean. On another trip, with a foreknowledge of the ease of examination of living specimens, and consequently a wholly new set of apparatus, I hope to approach much closer to the meaning of their lives.

CHAPTER IX

COCOS—THE ISLE OF PIRATES

BY WILLIAM BEEBE AND RUTH ROSE

I LOVE to think of the meeting places of the great elements, as where I sit in my bow pulpit in mid-Pacific. The sea is mirror calm with only the silent slipping past of lazy swells, more like evanescent breaths on glass than actual movement. So clear and blue and still is the surface that I cannot tell where the liquid begins and the air ends. Now and then the bow dips and my feet gently sink below the surface. The air is quiet and neither hot nor cold, and the world is perfect, with all mankind and his works out of sight behind me. I sit and solemnly make notes on the creatures I see, I ponder and wonder, and finally I am utterly discouraged at the thought of hoping to know the things of this planet any more clearly. Then comes a comforting thought, that after all I cannot expect to do much with a brain which has only one-ninth of tissue and substance to hold together the eight-ninths of water.

Five distinct and separate smudges of rain beaded the horizon, and as my eye played idly over

these, one cloud lifted with amazing rapidity and revealed Cocos Island, clear and green, as the handkerchief of a conjurer is raised and displays a bouquet of exquisite flowers where a moment before there had been nothing.

I climbed at once up to the bow where I commanded a wider prospect. As Cocos—alive with legends of pirate hoards of gold, with every headland and inlet named after some brigand of the sea—as Cocos appeared before us our approach to the island became perfect,—our escort began to form. As we neared it, great numbers of dolphins, those souls of drowned sailors, raced toward us in tens and tens and twenties, and gathered in all but solid layers about the bow and along the sides. I have never seen such hosts packed together. When we slowed up so that we could photograph them to better advantage, they all slackened speed and merely dipped and curved lazily in one spot, sighing as they exhaled.

Long before the island showed any detail, boobies, the long-familiar red-foots, and a wholly new green-foot, hailed us as the newest things in convenient perching places, the best dead trees they had ever seen, and our ratlines and wireless were crowded so that the birds touched each other. A few frigatebirds passed, some pure white terns swooped in the distance and—Cocos vanished. Over it, dark clouds materialized out of nothing, and the smoothness of the forested mountains became blurred and streaked with rain. Then a great curved arch of pale grey etched into the black

rain cloud, a stain of some indefinable color appeared, deepened, and the island was crowned by a rainbow so brilliant that its edges seemed to carry human vision much farther along the scale than usual,—our eyesight almost interdigitating with heat on the one side and sound on the other.

With the disappearing of Cocos into the enveloping rain-clouds, my mind went back into equally obscure years of past centuries, when mankind first sighted this oceanic speck.

The discoverers of the Galápagos did not think enough of their find to attach a name to those islands which they were the first to see. But the man who discovered Cocos was even more indifferent, for he appears not to have so much as mentioned the circumstance that he had chanced upon this scrap of tropical jungle afloat in the Pacific, far from sight of any other land. At least, such a conclusion is an explanation for the fact that there seems to be no record of the first voyager to set eyes on its steep shores, laced with waterfalls.

The first map on which Cocos is shown is that of Nicholas Desliens, in 1541. This was six years after Berlanga, Bishop of Panama, reported his accidental discovery of the group afterwards known as Galápagos. No doubt Cocos was as fortuitously found, perhaps by some Spanish captain exploring the new domains of the mother-country, perhaps by a filibuster fleeing with booty from the mainland. Malpelo Island was already well-known, as most of the ships plying those waters could hardly have helped seeing it, and the Galá-

pagos were scattered over such a wide expanse of ocean that they were likely to be seen now and then. But Cocos had an elusive quality which it has not completely lost even yet. Surrounded by strong and tricky currents, concerning which much remains to be discovered, and very often veiled by such heavy mists and rainstorms that a ship may pass within a few miles without glimpsing a trace of land, the very existence of such an island has been denied in comparatively modern times.

Of course in the 16th century, when navigation was more an art than an exact science, it is easy to understand that the precise position of Cocos was difficult to establish, and long after its discovery it was located at the caprice of the geographers, now south of the Equator, now north, moving from side to side, and on some maps completely ignored. For a while another island called Santa Cruz was figured as lying to the northeast of Cocos, probably named by some navigator, who, obtaining a wrong position, thought that he had found a new island, which was really the ambulatory Cocos.

At last Cocos came out fresh and green from her shroud of rain, and we slowed, sounding every few yards, drifting nearer and nearer until the heights of Nuez Island were well abeam to starboard, and Cocos itself loomed high over us. At the signal, in seventeen fathoms, the chain clanked and jangled through the hawse hole and we swung around head on to the stiff alongshore current.

Here at last, on the ides of May, we were close to Cocos, three hundred miles off Costa Rica. It

rose before us tiny and mountainous, only about three and a half miles across, with two peaks in sight, deep-seamed with ravines, one of which was almost twenty-eight hundred feet in height. Here and there off shore were a scattering of rocky islets, but, as we later found, the bottom of the sea dropped abruptly downward in all directions. No greater contrast could be imagined than between Cocos and the Galápagos—the one wet and green, the others dry and brown.

Night came quickly, dark, with swift scudding clouds and an occasional hint of subdued moonlight. Hoarse, disembodied cries drifted down through the night, and the restless waters of Chatham Bay lapped along our vessel, as jungle grass brushes against the sides of a smoothly moving elephant.

Dawn broke with the silent impetus of the tropics, and breakfast on this day lost all hint of a social rite, and became a hastily performed physiological necessity.

Our atavistic pirate threw his tiny Panama dug-out and paddle overboard, dived after, baled it, crawled in, and sped shoreward, in the same spirit with which a pilgrim comes within sight of the Kaaba. No devotee ever climbed the seventy-two steps of St. Anne de Beaupré with more reverence than Don Dickerman, tumbled ashore by the breakers, crept up the pebbly beach.

I followed quickly and our little outboard motor vibrated rapidly across the bay. Great shadowy forms passed beneath, and now and then we had to snap the tiny propeller out of water as a giant

grouper made a rush for it. Smooth white sand alternated with coral skyscrapers and volcanic villages, fathoms beneath the clear water. I did not realize at that time that soon I would be walking the streets of this submarine world, and making my manners to their inhabitants. At the head of the bay series after series of three great rollers curved and broke, so I chose the eastern side where the surge struck obliquely against a line of mighty lava boulders. Rowing in stern first, I chose a moment of equilibrium, and leaped out, bracing myself as a waist-high surge swept past. Guns, nets and cameras were passed along and our first day on Cocos began.

Wherever we went the way was barred by vegetation through which we had to force our way. The only passable paths were up the center of the rocky streams which leaped and swirled down from the high interior. Four-fifths of the island is on end, with slopes so steep that the trees are set in at most acute angles. The rain which falls heavily for many months of the year keeps the island as saturated as a sponge, and the squashy yellow clay and dripping vegetation seem seldom to become even approximately dry.

I walked along shore beneath groves of giant tree-ferns whose lacey foliage fretted the sky overhead. Every now and then a silver column of water would appear, falling from high up on the mountain, to spend itself in spray and a trickle over the pebbly beach. The sun came out and the whole island glistened like a jewel with a myriad facets.

I came to a large stream and found a great boulder a few yards inland which gave a sight of the shore and of a glade at the forest's edge. Great orange and black brassolid butterflies hovered about the masses of morning-glories, hibiscus and clusia blossoms near by, while my view seaward was seamed by a hundred vertical lines of aerial rootlets, dropping from fig-trees high above.

A sharp cry drew my attention to a bird swinging in a curve out from shore, sandpiper fashion, and when it alighted I knew it for a wandering tattler. Then a black spot on the sand exposed by the ebbing tide turned out to be a grey Galápagos gull, so interesting a straggler that I later secured it. It was pecking at an old fish, and as I watched I saw a small something run a few feet away. My glasses showed a large rat—apparently of the usual ship's kind—mangy to an unpleasant degree, much of the hair being gone from its back. It was munching a bit of old fish. Cocos was revealing strange inhabitants with still more strange habits.

Suddenly the island, and tree-ferns and tropical-smelling jungle vanished in the haze of memory which a happy, lilting little song aroused, and on a branch a few feet away a yellow warbler sat and sang to me over and over his simple lay, which so often has meant early spring in my northern home. This bird is the same as the Galápagos warbler.

There are only four species of land birds on Cocos and later in the morning, within a period of fifteen minutes, I saw all of them without moving from my boulder. A flash of rufous and a throaty

note revealed the only species of insular cuckoo, my warblers were all around me, and then there came to my ears the sharp snap of a bird's beak and on the tip of the barrels of my gun which I had left propped against a rock, perched the Cocos flycatcher, hardly to be distinguished from the little olive-green Galápagos chap. In silence, finally came a small flock of the only finch, anomalous little birds with rather slender curved beaks, the males in black, the females mottled with olive and buff as though permanently saturated by the everlasting rain. They flitted from twig to twig, playing at warblers, finches and titmice in their feeding habits. All the species of birds were seeking flying ants, small beetles and caterpillars.

A favorite feeding ground was at the limit of high tide where I saw all but the cuckoo again and again. Here, too, came the ugly rats and twice we saw domestic cats, quite as wild as leopards, tearing at decayed fish, snarling at us and dashing away at our approach. The birds were as tame as those of the Galápagos, and when they were not seeking for food they were investigating us. On almost every tree were little *Anolis* lizards, scampering up and down the bark, and in flecks of sunlight expanding their relatively enormous, flat, bright yellow throat wattles both to charm their mates and to intimidate their rivals.

I picked out the nearest ridge summit and struck upward along an open grassy slope which, from the *Arcturus*, had looked like soft clover. In reality it was far different—a sort of elephant grass, six

to eight feet in height, with a saw-toothed edge which would cut to the bone if rubbed the wrong way. This we proceeded frequently to do, and when half-way up and making our way on knees and elbows, we discovered a species of nettle hidden here and there, and this was varied by an occasional nest of stinging ants. When we reached the summit I decided to return by a circuitous route through a deep, jungle-filled gorge.

Here we had only to slop and slither through the ferns and mud, now and then disentangling a rope-like liana which threatened to handcuff or garrot us as we descended. Being thoroughly drenched already and very warm we purposely fell into the first big pool of the stream, lay on our backs and commented with vigor on the delights of any extensive search after treasure in this difficult isle. Overhead we watched most curious sights. Here were hundred-foot trees growing so densely that the sunlight was dimmed to twilight, and high up on the topmost branches were perched scores of sea-birds—frigatebirds, boobies and pure white fairy terns—as out of place to our eyes as would be a cloud of dust in this saturated world.

On our way down we spread a small net across narrow reaches of the torrent and caught great crayfish and curious little vacuum-cupped gobies. Once we saw a giant a foot long, and on another day captured it.

I was astonished at the abundance of insect life, for other explorers of Cocos unite in dwelling on its scarcity. We took moths, large and small, in-

cluding two species of beautiful, pink-spotted sphinx, several kinds of butterflies, large brown-winged grasshoppers with enormously long antennæ, funny little green cicadas, ants, mosquitoes, one small wasp, wood roaches large and small, and many giant dragonflies. Almost all these insects were clad in dull shades of black and brown, as were numerous beetles—elaters, long-horned, and weevils. One startling exception to this coloration was a weevil which stood out from the rest of the living creatures of Cocos as the daily rainbow contrasted with the somber storm clouds; indeed this tiny gem had its wing-cases dusted with a powder so glorious that under the lens it gave back every color of the spectrum, with emerald green as the dominant tint.

On my return to the *Arcturus* I frightened up a quartet of yellow-legs which flew after the tattler, and high overhead a hawk circled, the only one ever recorded for this island. The motor boat was anchored out beyond the surf and after fighting my way through the breakers and reaching the bow I saw a small green heron rise from the stern.

Directly after lunch I dived a number of times near the western side of the bay, at the first plunge taking down a good-sized aquarium with me. I had found it quite impossible to harpoon or catch the small blennies and other fish which crept about close to the coral, and many of which were new to me. In spite of the heavy surge I balanced the aquarium on its side on a block of lava, and baited it with several limpets, then waited, half floating in

mid-water, with a sheet of glass in my hand. When two rare, rose-colored blennies had entered I slipped the glass across the opening and had accomplished my object. But then things began to happen,—a heavy surge washed me sideways and not until I saw a mob of little fish excitedly clustered about my fingers did I notice the pale red cloud in the water and realize that I had cut my hand on the glass, and that the blood had drawn a swarm of these dainty vampires. Then a series of strenuous jerks on the hose notified me that something had gone wrong in the upper world, and I left the aquarium and began to grope and leap toward the ladder. To my surprise I seemed to make little headway, and then I looked back and saw that the anchor rope had chafed through and that my slender length of hose was the only connection between me and the boat. I redoubled my efforts and soon the Jacob's ladder caught for a moment on a projecting coral ledge and I reached it and swarmed up. A few days later we made an effort to find the aquarium but could never locate it. However, I know that the glass trap will work and I shall try it again some day on a much more extensive scale.

It was as well that I came up when I did, for by the time I reached the *Arcturus* a wicked blue-black squall was headed for us, and the waves were too high and choppy to be safe for a small boat. The storm came from across the island. I called back all the boats and made sure everything was safely tied down. The rain advanced in sharply delineated clouds, and instead of a solid sheet of flat

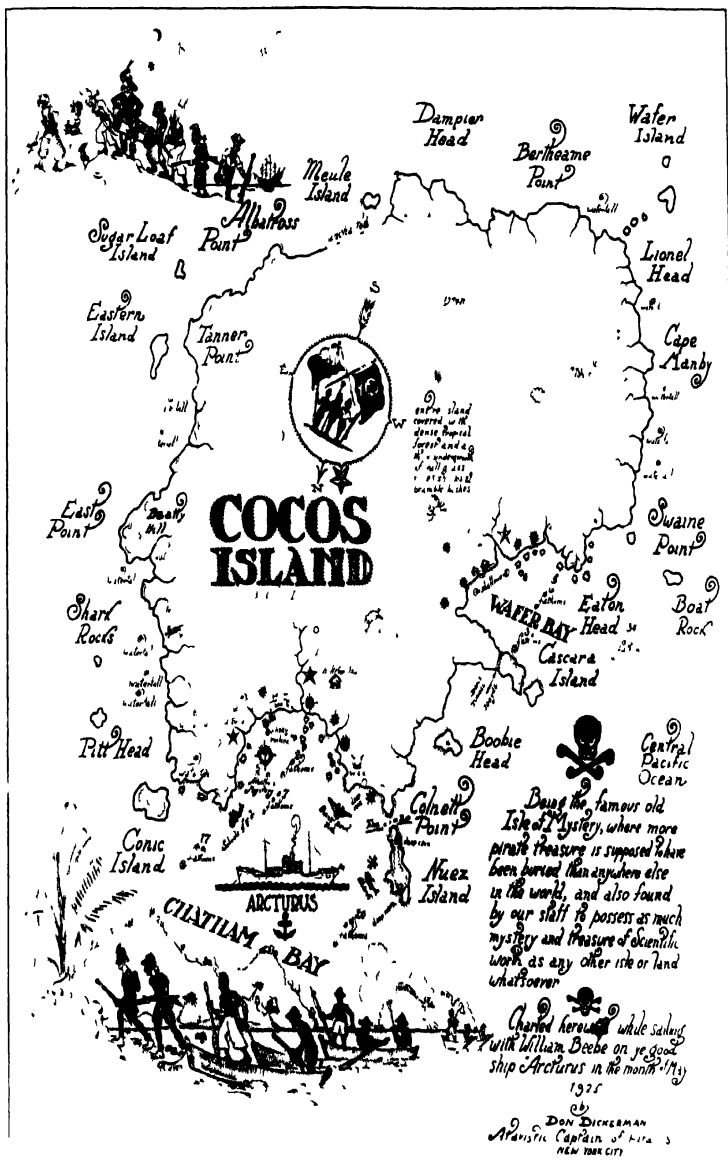


FIG. 36 — UNSCIENTIFIC MAP OF COCOS ISLAND

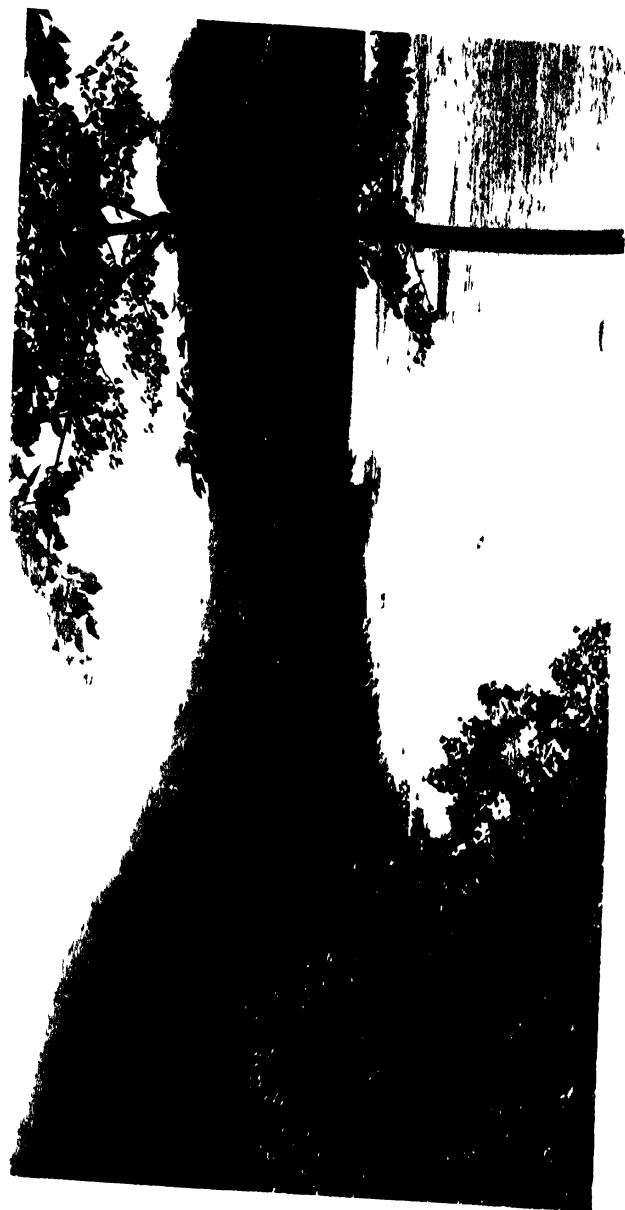


FIG. 37. GUAM BAY, CEOOS ISLAND.

Halfway down the bay is the freshwater stream where porpoises and whales for hundreds of years have quenched their thirst in Ceoos (their name).

green the island showed a host of unsuspected ravines and peaks, the onrushing downpour filling the first and silhouetting the latter, giving depth and perspective to the whole island, before blotting it out.

About nine o'clock at night the wind arose in earnest and was soon blowing half a gale. All the boats were tied alongside, rocking and pitching in the rising waves. The night was black as ink, with occasional squalls of rain, each followed by an equally brief and even more sinister duration of calm. Our lights were all on and the brilliant glow made the surrounding darkness the more impenetrable.

Throughout this entire night of storm, boobies by the hundred and noddy terns by the score flocked to the steamer, covering the deck and filling the boats. They seemed to lose all control of themselves when they came within range of the glare from the electric lights. Yet they did not dash into the light, but merely alighted near it and remained quiet, or flopped about and fought with each other. Nothing showed the complete absence of man from this island as much as this. The terrific wind and blinding rain utterly confused the birds. All doors had to be closed, for otherwise they filled the staterooms and laboratory, and their long, thrashing wings worked havoc until we ousted them.

Taking a bird by the tip of one wing I would swing it about my head and cast it far into outer darkness, when, like a boomerang, it would right itself, describe a wide circle and return. I tied my handkerchief to the leg of one giant, green-

footed booby, hurled it forth, and a minute later it was again at my feet, and I retrieved my property.

The Battle of the Boobies will never be forgotten by any of us. The silken swish of wind-driven rain, the thud and shriek of newly-arrived birds, the thrashing of powerful wings as they flapped against the deck-houses or engaged in gladiatorial combats, their hisses and screams when approached by us, and the shouts and helpless laughter of the embattled scientists, would have made a phonograph record that no uninitiated listener could have explained.

These birds nested by the hundred in low trees along the shore of Cocos, and were now returning from their fishing excursions to relieve their mates. Their crops were full of recently swallowed fish, and their first instinct after landing on the *Arcturus* was to deposit six to twelve neatly aligned, perfectly fresh fish on the deck. Comedy was added to this performance by the sight of Dr. Gregory, armed with a big enamel tray, solemnly following the waddling birds about, picking up, with a forceps, specimens of rare fish which the unfortunate birds had intended as breakfast for their nestlings. The food was chiefly small flyingfish, half-beaks and squids, with a scattering of smaller species, especially *Ophioblenny*. An ichthyologist never questions the source of his specimens!

Later in the night cross currents of wind set in and the small boats began to labor at their moorings, twisting on their painters and piling up on one